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THE DISTRIBUTION OF INSECTS IN WESTERN NORTH AMERICA.*

By Edwin C. Van Dyke,
University of California, Berkeley, Cal.

The fauna of the western part of North America has long been recognized as possessing many characteristics which have differentiated it from that found elsewhere in North America. This is particularly the case as regards the insects and Le Conte† as early as 1859 called attention to this. Other entomologists in more recent years have mentioned this fact and have cited many cases to show its peculiarity. The insect fauna as a whole, however, has not been studied in regard to this point, in the manner that it has merited.

Many years ago, I became interested in the subject and I have kept up my interest ever since and have availed myself of all opportunities that would enable me to gain information bearing upon it. I have studied all orders of insects to a certain extent, but most of my conclusions have been based upon a close study of the Coleoptera, particularly of the wingless and less mobile groups, such as certain of the *Carabidæ*, the *Silphidæ*, the *Tenebrionidæ*, the *Otiorychinæ*, and so forth. The other Coleoptera were used as checks as were in fact other groups of insects, and all other information bearing upon the subject of distribution in the territory under study, freely drawn upon for purposes of guidance.

* A revision of the paper read August 5, 1915, at the University of California, before the Summer Meeting of the Entomological Society of America.

† The Coleoptera of Kansas and Eastern New Mexico, by John L. LeConte, M. D., Smith. Miss. Contrib. to Knowledge, Vol. XI (1859).

As a result of these studies, I have come to believe that though the West Coast fauna is to a degree complex, it is yet made up of a definite number of elements which can be distinctly separated. The insect fauna as we now know it, has been derived from older faunas and these were either northern or southern in their origin. Each of these primary portions was in its turn composed of elements which had come into their present territory at different times and along different roads. Certain of these had remained pure and are at present restricted to definite areas, while others had either wholly or partially invaded regions already occupied by other elements and become mixed with them. These facts are of course in general in

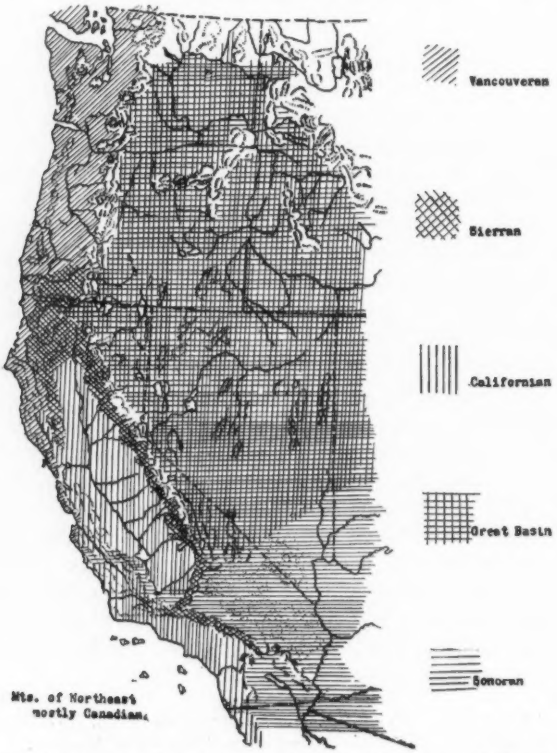

Fig. 1. Map showing the Faunal Areas of the Pacific States of North America.

keeping with those worked out by Merriam* and other mammalogists and ornithologists and substantiated by the botanists. Certain of the detailed results secured have, however, been found to be at variance with those found by others or to have previously not been worked out.

In general the insects which are considered to be of northern origin now occupy the northern and more mountainous portion of the territory. The greater portion of this, such as that including the lower levels of the Aleutian Islands, particularly the eastern ones, the southern margin of the Alaska Peninsula, southeastern Alaska, the western part of British Columbia as from the Selkirks west, Washington and Oregon west of the Cascade Mountains, and the wet and cool coastal strip of California, extending as far south as middle Monterey County, now supports a fauna which I have called the Vancouveran. The name Transitional as applied to this fauna, though generally used by previous workers, I consider misleading. The fauna is a pure one, in fact one of the purest in North America. It contains many peculiar groups of insects, some almost in their entirety, and is especially rich in such families as the *Carabidæ*, *Staphylinidæ*, *Elateridæ* and certain groups which are more or less closely associated with the coniferous forests. The following are good representatives: the genus Omus, the subgenus *Brennus* of *Scaphinotus*, the impunctate division of *Pterostichus*, *Zacotus*, *Metrius*, *Promecognathus* and the American representatives of *Trigonurus*. *Rosalia funebris* Mots. is also a characteristic member of this fauna, but it extends considerably beyond its confines. The fauna has existed in approximately its present territory from the Tertiary period and no doubt from well back in that period, being in fact a Tertiary fauna which has come down to us in a pure state. Many of the species that it contains have probably not changed during this long series of years but others have, some having become broken up into races which, becoming more and more isolated, have formed new species, subspecies, and so forth. As a result, the fauna is not the same throughout its extent. It gradually divides itself up into several subfaunas.

* The Geographical Distribution of Life in North America with Special Reference to Mammalia, by C. Hart Merriam, Proceed. Biol. Soc. Wash. Vol. VII, April 13, 1892.

The first of these occupies the following regions: the coastal belt of southeast Alaska and British Columbia with the adjacent islands, the Puget Sound Basin of Washington and the Willamette Valley of Oregon, and extends fully up to the five thousand foot level on the Cascades. This contains the Vancouveran fauna in its purest form and with its species but little modified throughout its extent. Characteristic Coleoptera of this area are *Omus dejeani* Reiche, *Cychrus tuberculatus* Harr., *Carabus taedatus* Fab., in its typical form, *Nebria mannerheimii* Fisch., *Pterostichus herculaneus* Mann. and *Pterostichus validus* Dej., and *Miscodera insignis* Mann.

Next we have a subfauna that might be called the Pacific Maritime. This occupies that very wet region to the west of the Olympic and Coast Ranges of Washington and with secondary modifications taking place chiefly in northwestern Oregon, in southwestern Oregon and northwestern California, in Mendocino County, California, and south of the Russian River in California, extends down the coast as far as middle Monterey County, California. Within this maritime area, the fauna as far as the species are concerned, is quite similar to that found in the pure Vancouveran, but the form and appearance of many of the species has changed. Melanism is markedly evident here and is to be noted in such widely separated families as the *Carabidæ*, the *Elateridæ*, the *Cantharidæ* (*Lampyridæ*), the *Scarabaeidæ*, and the *Rhynchophora*. Increase in size is also to be noted with regard to many of the species. To illustrate this, I will cite but a few examples. In the *Carabidæ*, in the genus *Scaphinotus*, we have the species *S. angulatus* Harr. which is of a metallic purple color in those specimens dwelling in the Puget Sound Basin and the Willamette Valley, and absolutely black in those which are found in the wet coast belt, though otherwise unmodified. In southwestern Oregon and northwestern California, a related but distinctly different species, *S. behrensi* Roesck, is found replacing the above. *Scaphinotus angusticollis* Fisch. in the pure Vancouveran region from southeastern Alaska to the eastern side of the Willamette Valley, is typically of a ferruginous color. West of the Olympics and Coast Range of Washington and the Willamette river in Oregon, it is absolutely black. In Washington, it is structurally the same as the typical form; in western Oregon, larger and with

the alternate elytral intervals more reduced or irregular; in southwestern Oregon and northwestern California, it occurs with a more angulate prothorax, still more modified elytra, and with the male tarsi somewhat changed; while in the southern part of its range, in Mendocino and northern Sonoma County, California, it appears as a much larger insect and much modified in every regard. In *Pterostichus amethystinus* Dej. we have a species with bluish elytra which extends from Alaska to middle Mendocino County, California. South of this, it is replaced by *P. scutellaris* Lec., a species which has absolutely the same habitat and only differs from the preceding by being all black. It extends into Monterey County, California. Among the *Elateridæ*, we have numbers of species which like *Athous ferruginosus* Esch., have a black phase within the southern maritime area. In the genus Silis, the species and varieties found along the coast and in the high mountains of the Pacific Coast are mostly black, whereas in the interior lowlands they are yellow. Among the *Rhynchophora*, we have one, *Rhynchites bicolor* Fab., one of the most widely distributed weevils in North America which has its only known black phase in the middle coastal belt of Oregon.

A second and more greatly modified portion of the Vancouveran fauna is that which inhabits a strip of country that starts in the west central part of Oregon, runs south and southeast, including all of the moderately elevated mountains in Southern Oregon and Northern California, and extends along the western flanks of the southern Cascades and Sierras into Southern California and with breaks, also into the San Pedro Matir of Lower California. This subfauna I would call the Sierran. It occupies much of the same country as that covered by the western yellow pine, and though it receives many species from those faunas found immediately above and below it, is in no sense a transitional one as often called. It is a distinct subfauna and a direct offshoot of the Vancouveran. Its species are almost always either like those to be found in the pure Vancouveran or are derivatives of the same. In the northern area of the Sierran subfauna, certain species show a strong tendency to break up into many weak races which are more or less limited to various small areas. This unstableness is no doubt partly due to climatic and partly to topographical conditions, for the country is much broken up, there being many

small ranges with variously exposed slopes. In the region extending from Mt. Shasta south to the American river, some of the offshoots of the primitive species have segregated themselves into rather distinct species and subspecies, serving thereby to define this as a rather distinct subregion and one with a fairly well defined secondary fauna. In the territory running from the American river south to the Merced river, we find marked off in a similar way another secondary faunal area; in the southern Sierras, quite another; while in the San Bernardino Mts. there is still another. These secondary faunas, though not well defined by the majority of the Sierran species, are yet very distinctly outlined by others, as for instance, by certain species of *Omus*, *Scaphinotus*, *Pterostichus* and *Pleocoma*.

Two of the North American faunas most closely related to the Vancouveran and two, which like it, are most likely remnants of the same northern Tertiary fauna, are one small fauna confined to parts of the mountains of western Idaho, the Coeur d'Alene and Moscow; and the fauna of the upper levels of the southern Appalachian mountains, the so-called Alleghanian. These two are relict and endemic faunas and possess as would be expected, many species or related species in common. In the Idaho fauna, we have certain species like *Pterostichus sphodrinus* Lec. which are closely related to those found in the Vancouveran like *Pterostichus ovicollis* Schaef.; and others as *Scaphinotus relictus* Horn and *H. merkeli* Horn that have their nearest relatives in *Scaphinotus imperfectus* Horn, *S. debilis* Lec. and *S. incompletus* Schz. of the southern Alleghanies. In *Pterostichus* we have a peculiar and small group of species that have more or less prognathous mandibles and are quite subterranean in habit. On the Pacific Coast we have three, *P. caligans* Horn, being the best known, one in Idaho, and *P. grandiceps* Ch. and *P. rostratus* Neum. in the Appalachian Mountains. All of the above mentioned species are so highly specialized that they cannot be anything but relicts. They could not possibly have migrated to their present abode subsequent to the Glacial Period, though like the last mentioned, they might have extended their territory.

In the Cascades and Sierras, at elevations immediately above those occupied by the Vancouveran and its offshoot, the Sierran, we have a fauna that is more alpine in its nature.

The lower belt of that fauna, that found within the fir zone, is generally spoken of as the Canadian, that immediately above it and in the more barren treeless areas as the Hudsonian, and that on the tops of the high peaks as the Arctic. These faunas are in reality marginal or fringing faunas. They fringe the snow fields of the mountains and the barren wastes of the north, advancing and retreating with them, and have done so not only during the present period, but undoubtedly during the entire portion of the Great Ice Age, and I believe even before that were only to be found in the cooler areas of the north. During the period of greatest ice development, the Pleistocene, they were driven down to the lower levels and forced much farther south than they were before. With the decline of this period, they retreated both upwards and northward. At the more southern limits of their distribution their retreat was often prevented by breaks in the ranges or by the lowness of the mountains so that their continuity was interrupted leaving as we find today little islands of fauna here and there restricted to the more elevated parts of the high mountains.

The first of these, the Canadian, is in the west almost entirely a forest loving fauna. Where it comes in contact with the Vancouveran and Sierran, it blends to some extent with them and as a result is often hard to separate. It has also borrowed many species from these as they have from it. It commences in the north as a continuation on to the mountains of that extensive lowland fauna which populates the vast areas of western Canada. Then it continues south along the mountains, at first as a rather broad belt, later as a much narrower one, and wedged in between the Vancouveran and Sierran, and the Hudsonian on the west slopes; and the Great Basin fauna, a portion of the so-called Upper Sonoran, and the Hudsonian when the mountains are sufficiently high for that, on the east side. Its forest types of Coleoptera are fairly characteristic, such as many of its *Elateridæ* and *Cerambycidæ*, but its *Carabidæ* are less so. *Pterostichus protractus* Lec. and *Platynus bogemanni* Gyll. are, however, quite distinctive of it in the more southern Cascades and the Sierras.

The Hudsonian is in most places a very narrow zone, but it is very distinct. In Alaska, it is found on the uplands of the Aleutian Islands, on the mountains and the north side of the Alaska Peninsula, to quite an extent about the Kenai Peninsula,

and thence south along the flanks of the ranges which fringe the Coast. In British Columbia it is more inland and on the higher mountains and it continues as such along the Cascades of Washington and Oregon and the Sierras of California, but gradually ascends as it extends southwards. In the Cascades, as on Mt. Rainier, it is found at about seven thousand feet, on Mt. Shasta at eight thousand, in the Lake Tahoe region near nine thousand, while in the southern Sierras it is well above ten thousand feet. A few of its more widely distributed and characteristic beetles are *Nebria sahlbergi* Fisch., *Bembidium incertum* Mots., *Amara erratica* Sturm, and *Cryptohypnus bicolor* Esch. Besides these, there are certain others which are only to be found in the mountains of the West but which, because of certain peculiarities of distribution throw so much light upon the problem that they are worthy of being especially mentioned. Such is *Nebria trifaria* Lec. a large and very attractive black species. This is undoubtedly a glacial relict, for it is now only to be found high up near the snow fields on the Olympic Range, Mt. Rainier and Mt. Jefferson of the Cascades, and the Rockies of Colorado. The rare *N. ingens* Horn of the high southern Sierras, which differs from the preceding chiefly in having very much rounded humeri and atrophied wings, is, I am convinced, but a degenerate offshoot of the preceding which was forced south and later entirely separated from the parent stock. *Nebria ovipennis* Lec. and its three associated species are also of importance from the same viewpoint. They are all of moderate size, entirely apterous, and with elliptical elytra, hence extremely specialized and dependent upon their particular environment. The most northern, *N. kincaidi* Schw., an entirely metallic species of a purplish copper color, has been found close to the coast at Farragut Bay, Alaska, and near the snow fields on Glacier Peak and Mt. Rainier, Washington. A second, *N. columbiana* Casey, which resembles the preceding, but has only the elytra metallic, was described from British Columbia, but has also been found on Glacier Peak and Mt. Rainier, Washington, and Mt. Jefferson, Oregon. The third, *N. ovipennis* Lec., which is but an offshoot of the preceding and differs only in color, being entirely brownish or piceous, in other words more heavily pigmented, is to be found on the higher peaks of the Lake Tahoe region in California and above 10,500 feet in the southern

Sierras. The fourth species, *N. diversa* Lec. is of a yellowish color and is confined to the sea coasts of Washington and Oregon. The only close relatives that these four have are certain species found in the more eastern part of the Himalayas and in northeastern Asia. The last beetle to be mentioned in this connection shows another peculiarity of distribution due to the retreating ice. This is *Pterostichus brunneus* Dej., a species first described from Sitka on Baranoff Island, later found on Orcus Island near the mouth of Puget Sound and no doubt occurring on other islands in the same general region, and on the mainland only high up near the timber line as in the Selkirks of British Columbia, on Glacier Peak and Mt. Rainier in Washington, and on Mt. Jefferson in Oregon. On the islands, it was left stranded, but by adaptation was able to persist, while on the mainland it could preserve its natural environment by merely retreating with the ice to the higher levels.

The faunas of southern origin are to be found in their purest state only in the more southern part of our territory though derivatives of the same do in certain regions extend quite far to the northward. The best known of these is the Sonoran which, when considered in its strictest sense, may be said to occupy all those hot and more or less barren uplands in northern Mexico and the semi deserts and drier regions of our own Southwest, with extensions into western Texas, southern New Mexico and Arizona, and the more desert parts of southeastern California. The fauna of the Colorado Desert as well as that of its more upland extension, the Mojave Desert, is typically Sonoran. Certain elements of this also extend more westward along our southern border to the coast at San Diego and from the Mojave through the hot Walker Basin into the southern San Joaquin Valley. Here it is to be found mainly on the west side of the valley as in western Kern County and in an attenuated form in southern Monterey County. Some of its most characteristic beetles are among the wingless *Tenebrionidæ*, such as in the genera *Edrotes*, *Triorophus*, *Zopherus* and *Asida*, and in the wingless *Otiorychinæ* like *Ophrastes* and *Eupagoderes*, and the genus *Monilema* of the *Cerambycidæ*.

A derivative of the Sonoran fauna which is generally spoken of as the upper Sonoran, though it is more accurately defined as the Great Basin fauna, extends throughout the entire area

between the Rocky Mountains and the Sierra Nevadas, and thus includes northern Arizona, California east of the Sierras, Nevada, eastern Oregon and eastern Washington, Utah, parts of Wyoming, the lowlands of Idaho, and reaches its northern limit in the Okanagan Valley in eastern British Columbia. Certain portions of this fauna also break through the mountain barriers on the west and thus extend themselves. South of Mt. Whitney a portion passes through the Walker Basin in company with the more typical Sonoran and extends into the San Joaquin Valley. Another portion runs westward from Modoc and Lassen Counties and passing north of Mt. Shasta, invades the northwestern part of Siskiyou County. The insects of this fauna are generally derivatives of the true Sonoran so not sharply differentiated. The *jejunas* group of the genus *Platynus*, *Agrilus walsinghami* Cr., and the hairy group of *Eleodes* are perhaps as characteristic as are any Coleoptera that we have in the subfauna.

That other southern fauna, the one which comprises the greater portion of the insect population of the southern part of California, is not a derivative of the present Sonoran. It is a fauna which has come to us directly from the south through Lower California and presumably in earlier times from lands farther to the south. It is very old and very distinct, having many genera and the bulk of its species totally different from those of the Sonoran. It came into California long before the Sonoran did and consequently is more thoroughly established in southern and middle California. The species are now some of the most characteristic within the state and the fauna as a whole is so dominantly Californian that it might be called the Californian fauna. It is now to be found not only throughout all of Southern California west of the San Bernardino and Sierra Madre Ranges, but along the coast to San Francisco, throughout the more southern portion of the Coast Range, and the greater part of the San Joaquin and Sacramento Valleys, extending as far north as Shasta County. In the drier parts of the state, it is therefore even more dominant than the Sonoran and it sends many of its characteristic forms well within that claimed by the Vancouveran and Sierran as in the foothill regions of the more northern Coast Range and the Sierra Nevada itself, thus sharing equally with the faunas of northern origin, the possession of the land. At one time, the

northern species extended much farther south than at present and in general were more in evidence in the south than now, but within recent times they have undoubtedly both retreated and decreased in numbers in the southern areas. The southern forms have, on the contrary, been doing the opposite so that they have gradually supplanted the preceding. This, therefore, accounts for the fact that there are islands of northern forms within the territory occupied by southern forms. Wherever southern forms have run north, they are always to be found connected with their basic stock in the south, no matter how far north they have gone and no matter at what time they advanced. Some of the characteristic species of the Californian fauna are the members of the *dilatatus* group of *Anisodactylus* in the *Carabidæ; Dystaxia, Schizopus* and *Glyptoscelimorpha,* in the *Buprestidæ; Ipochus fasciatus* Lec. in the *Cerambycidæ; Phloeodes, Coelus, Eulabis, Nycotporis, Cibdelis* and *Coniotis,* in *Tenebrionidæ;* and *Trigonscuta* and *Rhigopsis* in the *Otiorychinæ.*

Our west coast fauna we thus find has the bulk of its species of insects included within the very old Vancouveran fauna and the equally old Californian fauna, two faunas that are restricted to the Pacific Coast and that have passed through the Pleistocene without much injury to themselves. Supplementing these, are the several marginal faunas of the mountains and the desert faunas of the southeast. The Vancouveran, like those found in the mountains of western Idaho, and in the southern Alleghanies, is a relict fauna, a remnant of a more or less upland fauna which was widely distributed throughout the more northern parts of North America during Tertiary times. It is the largest remnant of the three and is only surpassed among similar fauna by that of the Japano-Manchurian region. The Californian is quite isolated though it shows a strong relationship to that found in the more barren parts of northern Chili and Peru. The marginal faunas on our mountains link up our territory with that to the north and northeast of us and the Sonoran does the same with regard to the country to the southeast. Certain of our peculiarities can also be indicated by considering the subject from a negative standpoint. For instance, we find that very little of the Neotropical or tropical fauna of South America, has reached us, whereas quite a noticeable amount has found its way into eastern North America. *Diabrotica soror* Lec. is one of our few derivatives

from that. We also lack the most characteristic elements of those faunas, the Austro-Riparian and Carolinian, which are such a feature of the eastern part of North America. Thus we have but a few *Scarabaeidæ* and few *Chrysomelidæ* as compared with the East; no representative of *Lucanus, Copris, Onthophagus, Anomala* and but few of *Phyllophaga* (*Lachnosterna*) from among the *Lamellicorns;* but a weak representation of *Melanotus,* an Elaterid genus rich in species in the eastern states; and not a single species of *Evarthrus, Pasimachus* and *Dicaelus* from among the Carabidæ. Hence we may say that the fauna of western North America as a whole when judged from the standpoint of its insects, is a most distinct one, yet one which can be linked with the faunas of the rest of the world.

A NEW CHALCID-FLY PARASITIC ON THE AUSTRALIAN BULL-DOG ANT.*

By CHARLES T. BRUES.

Several decades ago, Professor August Forel† found in cocoons of the large Australian bull-dog ant, *Myrmecia forficata* Fabr., two specimens of a fine Eucharid. He recognized them as parasites of the ant larvæ and sent them to the English hymenopterist, Peter Cameron, who described them as *Eucharis myrmiciæ*.‡ This was the first record of a Eucharid parasite of an ant, although several other genera have been reared subsequently from other ants and it seems likely that all of the Eucharidæ are ant-parasites.

Very recently Dr. R. J. Tillyard, of Hornsby, New South Wales, bred from a cocoon of *Myrmecia gulosa* another Eucharid which he sent to Prof. W. M. Wheeler, who has published accounts of the habits of Orasema and several other genera.§

The species reared by Dr. Tillyard is quite distinct from *Eucharis myrmiciæ*, although I suspect that both may belong to the same genus. Cameron's species is undoubtedly not an Eucharis as that genus is at present restricted and it may perhaps be a Psilogaster to which I believe the new species is referable. Psilogaster was first proposed for an Egyptian species by Blanchard and recently another one from Abyssinia has been more carefully described and figured by Reichensperger+ as *P. fraudulentus*. In addition to these, Dr. Wm. M. Mann tells me that he has a new species which he hopes soon to describe, taken by him in the Solomon Islands. The Abyssinian form occurs with *Pheidole megacephala*. Both of the African species have 11-jointed antennæ as does a Tasmanian Eucharid described by Walker as *Psilogaster pallipes*. Recently Girault has added one from Australia with 10-jointed antennæ, and has proposed the genus *Parapsilogaster* for another with 12-jointed antennæ. Since it is a difficult matter to say

* Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 152.

† Am. Soc. Ent. Belgique, Vol. 20, p. 8. (1890).

‡ Mem. & Proc. Manchester Lit. & Philos. Soc., Vol. 4, p. 187. (1891).

§ Bull. American Mus. Nat. Hist., Vol. 23, pp. 1–93 (1907).

+ Zool. Jahrb. Abth. f. Syst., Vol. 53, pp. 185–218. (1913).

whether the apical part of the antenna ("club") consists of one, two or three separate joints, descriptions without figures may be misleading on this point. The species bred by Dr. Tillyard from Myrmecia differs considerably from *P. fraudulentus* in both the adult and pupa and as they occur with such different ants they may quite likely prove to be generically distinct. In accordance with the large size of Myrmecia, it is more than twice the size of the Abyssinian parasite of Pheidole and by reason of its striking color pattern may be very readily recognized.

Psilogaster fasciiventris sp. nov.

Imago. (Plate I, Fig. 2). ♀ Length 7.5 mm. Head and thorax greenish bronze, less greenish and with purple reflections on the propodeum; abdomen piceous, with transverse yellowish bands, orange yellow on the second segment and lighter yellow on the following segments; band of second segment narrowly interrupted on the median line and curving forward on the sides to near the apex of the petiole, separated by its own width from the apical margin of the segment; those of the following segments of similar form, but not interrupted medially, that of the fifth widened medially and angularly extended forward; petiole black with a purple cast; antennæ ferruginous, scape lighter; mandibles light brown; coxæ black, the front ones bronzed; femora fulvous; tibiæ and tarsi pale yellow, last tarsal joint black at apex; wings hyaline at base, brown elsewhere, more deeply so anteriorly near the middle. Head much narrower than the thorax, fully three times as broad as thick; posterior margin slightly concave; face below the antennæ transversely striate, the striæ continuing over the cheeks and upward behind the eyes and across the occiput; occipital margin raised; ocelli in a nearly straight line, the posterior ones nearly as far from one another as from the eye-margin; antennal basin transversely striated; eyes bare; malar space nearly as long as the eye; antennæ 11-jointed, scape twice as long as thick; pedicel very short; first flagellar joint as long as the scape and pedicel together, over three times as long as broad; following joints growing shorter, the seventh and eighth less than twice as long as thick; apical one longer. Thorax above coarsely rugose-reticulate; parapsidal grooves impressed only on posterior half; scutellum without distinct

median furrow or depression; separated from the post scutellum by a shallow groove, the two together acutely convex at apex, but without teeth or projections. Propodeum flattened and elevated medially, the sides of the central part convexly elevated at the sides, lateral to this with a deep groove extending to the hind coxa separating the lateral part which is acutely convex above near the root of the hind wing. Pleuræ sculptured like the mesonotum. Petiole of abdomen as long as the slope of the propodeum; second segment twice as long as the third and fourth together; following very short, not visible from above; apical margins of the second and third segments deeply excised medially. Tarsal claws simple. Submarginal vein thickened on its apical third; marginal half as long as the submarginal and fully four times as long as the short, stout, nearly perpendicular stigmal vein; postmarginal extending about half-way to tip of wing, but gradually evanescent at tip.

Type from Hornsby, New South Wales, in the writer's collection, bred from cocoon of *Myrmecia gulosa* by Dr. R. J. Tillyard.

Male. A pupa (Plate II, Fig. 2) shows twelve distinctly separate antennal joints and is, I suspect a male, and the apical joints are longer, more slender and of approximately equal length. In the female, if the lengthened and constricted 11th joint were regarded as two joints, the apical one would be much shorter than the penultimate.

Planidium, or First Larval Stage.

There are no specimens of this instar, but the cast skin of one was found still attached to the mature larva described below. This exuvium was firmly attached to the under surface of the thorax just behind the head and I have been able to remove it almost intact. When mounted in balsam it gives some idea of the structure of the planidium which proves to be very similar to that of *Perilampus* as described by Smith.*

Compared with Smith's figure (1912, p. 46, fig. 26 d), of the engorged planidium it appears to have eleven sclerites behind the head, while Perilampus has twelve. The apical plates are very small, however, and quite likely the number is the same in both genera. The head is separated from the

* Bull. U. S. Dept. Agric., Bur. Ent., Tech. Ser. No. 19, pt. IV, pp. 33–69 (1912) and Psyche, Vol. 24, pp. 63–68. (1917).

rest of the dorsal integument in the cast skin, showing that ecdysis must be accomplished by the formation of a dorsal rent behind the head. The thoracic and abdominal plates, except the last three are widely separated by the enormously distended membrane, so that they appear as widely separated bars like those of a much swollen termite queen. The first or prothoracic plate is broader than the others and crescentic, being deeply emarginate in front. The three following are narrower and but slightly curved; the following become gradually smaller to the minute apical one. At each side of each plate is a more or less triangular, paler extension, separated by a fine clear line; these probably represent pleural plates; they are similar to those of Perilampus in having the tip prolonged into a long bristle-shaped point, but the posterior edge bears several short teeth instead of bristles. Between the plates and on the ventral surface, the membrane bears some bristly hairs as in Perilampus, but the arrangement of these cannot be made out clearly in the specimen. I find no trace of the caudal bristles present in Perilampus, but these may easily have been lost in ecdysis.

Larva. Full-grown, length 12 mm. There is a single larva, evidently full-grown and ready to molt into the pupal condition as the appendages of the pupa are to be seen through the skin. The body is rather stout (Plate I, Fig. 1) nearly straight and broadest near the posterior end. At the anterior end there is a large vesicular swelling which extends ventrally, behind it on the ventral side lies another smaller swelling which evidently represents the head and mouthparts, although no definite structures can be made out. Dorsally, and to a less degree on the sides and below, the surface of the body is undulating, indicating eleven segments, including the anterior vesicle previously referred to. Of these segments the three anterior ones (thoracic) are larger than the basal abdominal ones, although the last several abdominal segments increase in size till the sixth is the largest body segment; beyond the segments become rapidly smaller and bent down ventrally; finally at the apex on the ventral side of the body is a minute tubercle which evidently is a twelfth segment. The surface of the whole body is clothed with minute, colorless, sparsely placed hairs which undoubtedly function as exudate organs.

Pupa. (Plate II, Figs 1, 2, 3). Length 15 mm. Elongate and slender, with the abdomen not noticeably swollen and not curved downward, the whole body with vesicular swellings. The head is bent under the thorax so as to be scarcely visible from above, but its projections extend forward as a central bifurcate, transversely wrinkled papilla and another one at each side projecting forward and outward. The mesonotum bears a small rounded tubercle at each side of the anterior edge, an acute one near each tegula and a widely separated pair of sub-acute ones on the disc before the scutellum; otherwise the integument is simple except for a raised, longitudinally wrinkled area between the anterior pair of tubercles. There are no tubercles above the propodeum and petiole like those figured by Reichensperger (*loc. cit.*) for *P. fraudulentus.*

Abdomen narrowly oval, broadest near the anterior end, composed of five apparent large segments and a short apical one, followed by a portion which appears to be retractile and composed of several fleshy segments, terminated by a polliciform projection. Dorsally the five large segments are separated by sharply elevated transverse ridges, each interrupted narrowly along the median line. At the median end each is elevated as a tooth, again as a more conspicuous and longer tooth at the lateral end, which is well down on the side of the body; midway between there is another tooth. Between the large teeth, especially near the dorsal line, there are more or less distinct minute denticulations. The ridges between all segments are very nearly of the same size, except that the lateral tooth-like projections of the first are much larger. The ventral surface is clearly separated by a slight ridge and groove just inside the intersegmental teeth and is less convex than the dorsal surface; only the second to fifth transverse ridges are clearly indicated; they are continuous and much less conspicuous than the dorsal ones; the first is faintly visible and bears an anteriorly directed tooth at its middle. Seen from below, the dorsal surface of the short sixth segment extends further down than the others leaving only a narrow ventral part which is conically elevated; in addition the apex of the fifth ventral segment bears a pair of closely approximated tubercles at apex; following retractile segments without distinctly separated dorsal and ventral surfaces.

Described from one perfect and several damaged specimens.

The very great similarity of the planidium stage of Psilogaster to that of Perilampus is extremely interesting and suggests a close affinity between the Eucharidæ and Perilampidæ as has already been pointed out by Smith from a comparison of the planidia of Perilampus and Orasema. In fact, this stage of *Psilogaster fasciiventris* is almost as close to that of *Perilampus hyalinus* as the latter is to "Perilampus, species a" figured by Smith. In this case it may of course be possible that "species a" is not a true Perilampus as Smith did not succeed in rearing the adult. The host relations are very different in the case of the two families so far as is known; all bred Eucharids have been found to be parasites of ants while Perilampus has been bred from a diverse series of hosts, including Lepidoptera, Coleoptera, Neuroptera and some parasitic Hymenoptera and Diptera.

The later larval and especially the pupal stages are much more highly modified in the Eucharids than in Perilampus, although in the larvæ there seems to be much diversity in this respect. In the case of the larva, that of Psilogaster is comparatively simple, without conspicuous exudate organs, although it is well supplied with minute surface hairs which no doubt function as secretory organs of this type. Orasema possesses numerous, highly developed exudate tubercles arranged segmentally on both the thorax and abdomen. On the other hand, Perilampus shows similar conspicuous tubercles and projections, although it seems improbable in view of the host relations in this case that these can function as true exudate organs. In the pupa, that of Perilampus is simpler, although with small intersegmented ridges on the abdomen. In Orasema the pupa exhibits well developed transverse welts between the abdominal segments as well as some on the head. The climax appears in Psilogaster where the exudate organs are extremely large and elaborate as described in the present account.

There would seem to be two possible reasons for the presence of the highly developed exudate-like organs on the Perilampus larva. It might be that Perilampus is derived from Eucharid-like ancestors in which these organs actually functioned for the elaboration of an exudate, but this seems highly improbable in view of the much more specialized habits and structure of the Eucharidæ. On the other hand, it may be that the integumental modifications of Perilampus really do function as exudate

organs. But if such were the case it seems impossible to point out any way in which they might bear any relation to the host. It is of course possible that neither of the foregoing suppositions is true, and that the apparent exudatoria or blood spaces between the body and integument are simply adaptations to assist in ecdysis. Such can hardly be the case however, as they do not exist in other parasitic Hymenoptera with habits similar to those of Perilampus and in which ecdysis must be undergone under the same conditions.

None of these suppositions seems adequately to explain the structure of the Perilampus larva and pupa, and unless the exudatoria are functionless their presence must be due to some other cause. It is barely possible that they may bear a relation to the host other than those enumerated above.

It is known that the larvæ or many if not all externally feeding parasitic Hymenoptera secrete a salivary liquid which is injected into the host. This contains digestive enzymes which act upon the tissues to induce extra-intestinal digestion and a consequent liquefaction of the food material which is then more readily ingested. In ants at least, as has been pointed out by Wheeler (1918) there are undoubtedly cases where such secretions have both a digestive and exudatorial function. With this in mind it is possible that the secretion which is actually produced on the surface of the body of the Perilampus larva (*vide* Smith 1912, p. 50) may have a digestive function. With this hypothesis there is one difficulty; only a small part of this secretion could possibly enter the wound caused by the feeding larva in the host.

Of all these conflicting suppositions none appears satisfactorily to explain the conditions as they occur in Perilampus, and it is perhaps more likely that the exudatoria may have been present in the common ancestors of both Perilampidæ and Eucharidæ. If such be true, they have persisted in both families and have in the Eucharidæ assumed a secondary function as their exudates have proved to be attractive to the ants upon which they are parasitic. We may then believe that they were originally either secretory or excretory organs, or those assisting in some way in the process of ecdysis

Tubercular excrescences of somewhat similar appearances are to be seen in many larval insects of very diverse groups, *e. g.*, in many caterpillars, in certain parasitic beetles, in one

genus of bees (Allodape) and in some ants. In connection with some of these, Professor Wheeler has suggested to me that they may be of assistance in eliminating the large amounts of water ingested by rapidly growing insect larvæ. Quite recently Roubaud* has figured (p. 15) larvæ of the remarkable Rhipiphorid beetle *Macrosiagon ferruginea* which are external parasites of the wasp, Synagris. In these larvæ the body is covered with tubercles much like those of Psilogaster and Perilampus. Roubaud also found in the larva of a Braconid parasite occurring in the nests of Rhynchium, transverse welts of apparently similar nature (*l. c.*, p. 35, Fig. 14). In this case the Braconid larvæ (*Allodorus major*) feed not upon the wasp larvæ, but upon one of the caterpillars used for provisioning the nest. They develop at an unusually rapid rate, and on this account may easily require additional facilities for excreting water, particularly as they possess a closed alimentary tract and must excrete all excess water through the skin. The habits of a somewhat closely related genus of Braconidæ, Chelonus, have been described by Pierce and Holloway in America.† This species is an internal parasite and undergoes a much slower development, the larva requiring about three weeks to mature. These writers do not describe the larva, but it seems probable that they are not tuberculate, as such a peculiarity would undoubtedly have been mentioned. It seems probable, therefore, that at least one form related to Allodorus, but developing more slowly, lacks the welts present in Allodorus. This would appear to lend color to the suggestion made above, that the welted or tuberculated integument may function in excreting excess water.

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* Ann. Sci. Nat. Zool. 1916 Recherches biologiques sur les guêpes solitaires et sociales d' Afrique.

† Notes on the Biology of *Chelonus texanus* Cress., Journ. Econ. Entom., Vol. 5, pp. 425–428. (1912).

EXPLANATION OF PLATES.

PLATE I. *Psilogaster fasciiventris* sp. nov.

Fig. 1. Mature larva, lateral view.
Fig. 2. Female imago.

PLATE II. *Psilogaster fasciiventris* sp. nov.

Fig. 1. Pupa, lateral view.
Fig. 2. Pupa, ventral view.
Fig. 3. Pupa, dorsal view.

Fig. 1

Fig. 2

C. T. Brues

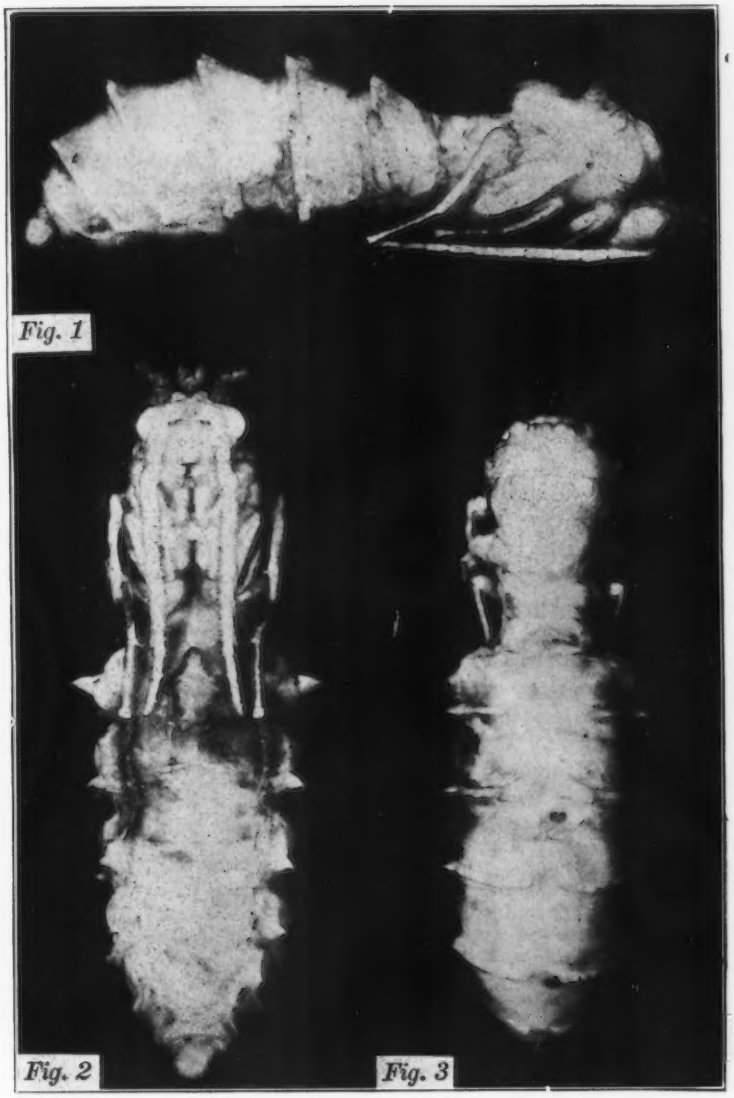

Fig. 1

Fig. 2

Fig. 3

C. T. Brues

NOTES ON THE CRANE-FLIES OF THE HAWAIIAN ISLANDS (Tipulidæ, Diptera).

By CHARLES P. ALEXANDER, Urbana, Illinois.

During the past few years some extensive collections of Hawaiian crane-flies have been received from Dr. James F. Illingworth and Mr. O. H. Swezey, to both of whom I am indebted for many favors. The records of these collections, together with a few additional specimens from other sources, are herein recorded to supplement our scanty knowledge of the Hawaiian Tipulidæ. A few general statements of the faunal constituents may be given.

As might be expected, the crane-fly fauna of the Islands is strongly endemic. The dominant genus is *Dicranomyia* with about a dozen species, all of which are apparently confined to the Islands. The remaining genera, *Libnotes*, *Styringomyia*, *Gonomyia* and *Trimicra*, are represented each by a single species, all, with the exception of *Styringomyia didyma*, apparently being endemic. This last mentioned species breeds in decaying organic matter, such as manure, and has probably been spread over the Australasian islands through the agency of man. The entire lack of the larger, vigorous Tipuline forms is striking, but entirely in agreement with the fauna of many other oceanic islands, where the Tipulinæ are entirely lacking and the dominant genera are *Dicranomyia* and related groups, (Seychelles, Guam, Fiji, etc.)

The following transcription of a letter received from Dr. Illingworth will give a clear idea of the conditions under which Hawaiian crane-flies are found. Under date of March 6, 1917, he writes as follows:

"Last week end I spent in the Waianae Mountains, which are at the far end of the Island. The range is much older than the mountains near Honolulu (Koolau) and the native insect fauna appears to be more abundant.

"I have never seen crane-flies more abundant, but I fear they belong to a few species. I followed along the stream which had many falls—every wet cavern was filled with them. I tried sweeping the grass along the banks but with no success. One only gets crane-flies in the mountains here and it is a rather difficult matter to get to the places where they are abundant. One or two common species come to the lamps in the low lands—these I have sent before."

Since the appearance of the Fauna Hawaiiensis (1901) in which Grimshaw describes practically all of the Hawaiian crane-flies, a new species, *Dicranomyia foliocuniculator*, has been described by Swezey. This latter species is of extreme interest because of the leaf-mining habits of its larvæ—a habitat that is unique in the family so far as at present known.

The types of the new species, with the exception of *Dicranomyia swezeyi*, are in the writer's collection; 'his latter type and paratypes of the other species were returned to Mr. Swezey.

FAMILY TIPULIDÆ.

Sub-Family Limnobiinæ.

Genus **Libnotes** Westwood.

Libnotes perkinsi (Grimsh.)

This handsome crane-fly is common and apparently well distributed throughout the Islands. It was described as a *Limnobia* but the reference to *Libnotes* seems more nearly correct. The following additional records from Oahu are at hand:

Honolulu, April 10, 1914 (O. H. Swezey).

Nunanu Valley, May 4, 1915 (A. H. Case).

The exotic genera that center around *Limnobia* and *Dicranomyia* include members which run very close to the above groups. In their typical condition these genera (such as *Libnotes*, *Dapanoptera*, *Peripheroptera*, etc.) are well defined, but the presence of less clearly differentiated species tends to break down all distinctions. Speiser (1909) described three African species of *Limnobia* (*Limonia*) that are, in my opinion, referrable to two other genera, *Libnotes*, (*rhizosema* and *oresitropha*) and *Rhipidia* (*miosema*). Other authorities, as Bergroth, Edwards, etc., include the species of *Dicranomyia* that possess a long subcosta in the genus *Limnobia*, disregarding all other features of organization, and despite the fact that Osten Sacken in his classic monograph of a half century ago clearly differentiated these two groups of *Dicranomyia*. In determining the generic limits of this division of flies, other features of structure must be considered, and the entire burden not placed on a single character. When this is done, the habitus of the insect and the smaller details of structure that are perceivable but difficult of definition, will aid in separating various groups. It is admittedly true that in many such cases the reference of species to genera becomes largely a matter of personal opinion. The

suggestion has been made that it would perhaps be better to consider these diverse Limnobiine genera as lesser groups, such as sub-genera, but in my opinion no benefit would be derived from such an action, since it would be exactly as difficult to separate and define these sub-genera. These various exotic genera are probably valid, but *Goniodineura* van der Wulp is doubtfully distinct from *Libnotes*.

Genus **Dicranomyia** Stephens.

Dicranomyia stygipennis, sp. n.

Coloration dark brown throughout, including the wings.

Male: Length, 6–7.5 mm.; wing, 7.5–8 mm.

Female: Length, 6.4–8.5 mm.; wing, 7.8–9 mm.

Rostrum and palpi dark brown. Antennæ dark brown throughout, the flagellar segments elongate-oval. Head dark brown.

Thorax dark brown, the pronotum a little yellowish. Legs dark brown, the extreme base of the femora a little paler. Halteres dark brownish black throughout. Wings with a strong brown suffusion; stigma rather distinct, of a somewhat darker brown. Venation: *Sc* ending about opposite the origin of the sector, Sc_2 close to the tip of Sc_1; *Rs* about twice the length of the basal deflection of R_{4+5}; cell *1st* M_2 closed; basal deflection of Cu_1 at the fork of *M*.

Abdomen dark brown. Hypopygium of male with the ninth pleurite small, only about four-tenths the length of the ventral pleural lobe; ventral lobes large, fleshy, the basal inner angle suffused inwardly, near its base with two powerful spines; dorsal lobes short, stout, slightly curved, the tip of each produced into a slender, blackened spine.

Holotype, ♂, Waianae Mountains, Oahu, altitude 2000 feet, March 5, 1917 (J. F. Illingworth).

Allotype, ♀, with the type.

Paratypes. Very numerous specimens of both sexes, from the type locality; Kaupo, Maui, altitude 2000 to 4000 feet, January 1, 1915 (H. T. Osborn); Haleakala, Maui, altitude 9000 feet, September 27, 1914 (H. T. Osborn).

This common fly is notable by its dark coloration. I would have identified it as being *D. brunnea* Grimsh. (1901) except for the discrepancy in the coloration of the wings. In any case, Grimshaw's name is preoccupied by *D. brunnea* Doane (Journ. Ent. N. Y. Soc., Vol. 8, p. 184; 1900), a fact that was pointed out by the author several years ago (Psyche, Vol. 18, p. 194; 1911).

Dicranomyia grimshawi, nom. n.

New name for *D. apicalis* Grimsh. (1901), not *D. apicalis* (Wied.) (1828).

Two males from Olaa, Hawaii, altitude 2500 feet (W. H. Ashmead), in the collection of the U. S. Nat. Museum.

Dicranomyia hawaiiensis Grimsh.

This beautiful *Dicranomyia* is widely distributed in the Islands. The following additional records of distribution are available. Island of Oahu: Honolulu, February 7, 1913 (O. H. Swezey); Palolo, February 8, 1914 (O. H. Swezey); Olympus, September 8, 1912 (O. H. Swezey); Waianae Mountains, altitude 2000 feet, March 5, 1917 (J. F. Illingworth).

Dicranomyia foliocuniculator Swez.

This recently described species is apparently common and widely distributed in the Islands. As stated before, it is unique in the leaf-mining habits of the larva, a habitat that will probably be found to be shared by other species of the Islands, especially *D. jacobus*, *D. swezeyi*, etc., forms that are undoubtedly related to *D. foliocuniculator*.

Numerous specimens are available from the Waianae Mountains, Oahu, altitude 2000 feet, March 5, 1917 (J. F. Illingworth) associated with *D. hawaiiensis*, *D. stygipennis*, etc. This locality has been mentioned in the introductory paragraph of this article. Waimano, Oahu, January 5, 1913, (O. H. Swezey). Iao Valley, Maui, altitude 700 feet, January 3, 1914 (J. F. Illingworth).

Dicranomyia jacobus, sp. n.

Size larger than in *foliocuniculator* (length of the male over 4 mm.); coloration of the body darker brown; wings with a decided brownish tinge.

Male: Length, 4.3–4.4 mm.; wing, 5.2–5.5 mm.

Female: Length, 5.1–6.5 mm.; wing, 5.8–6.2 mm.

Rostrum and palpi dark brownish black. Antennæ rather short, dark brownish black, the flagellar segments short, suboval to rounded, the apical segments more elongated. Head dark brown.

Neck rather elongated. Thorax very high and gibbous, dark brown, without stripes (in alcohol). Halteres rather short, the knobs large, the stem pale, the knobs darker, brown. Legs with the coxæ and trochanters brown; remainder of the legs rather dark brown. Wings light brown, the stigma indistinct, only a little darker than the remainder of the wings; veins dark brown. Venation: *Sc* short, Sc_1 ending about opposite or slightly beyond the origin of *Rs*; Sc_2 removed from the tip of Sc_1 for a distance about equal to cross-vein *r*; *Rs* long, somewhat arcuated, from two to three times as long as the basal deflection of R_{4+5}; cell *1st* M_2 large, as long as the veins issuing from it; basal deflection of Cu_1 just before, at, or even slightly beyond, the fork of *M*.

Abdomen dark brownish black, the sternites a little paler. Hypopygium with the ninth tergite almost straight across the caudal margin; pleurites rather short, shorter than the apical lobes; ventral inner side of the pleurite produced entad into a complex lobe which is expanded at its apex and bears at the inner margin a lateral cylindrical lobe with long hairs. Dorsal apical appendage a chitinized rod almost straight basally, toward the tip slightly bent inward and acutely pointed; ventral apical appendage a large fleshy lobe whose inner margin subapically is produced into a long, slender, cylindrical, chitinized point, rather blunt at the apex and here with a few hairs; at its base on the outer side with two sharp chitinized spines which are directed backward. Anal tube short, very broad, projecting slightly beyond the caudal margin of the ninth tergite, its apex feebly concave. Penis guard elongate, narrowed toward the apex which is bent strongly ventrad.

Holotype, ♂, Iao Valley, Island of Maui; altitude 700 feet; January 3, 1914 (J. F. Illingworth).

Allotype, ♀, topotypic.

Paratopotypes, 2 ♂'s, 2 ♀'s.

This insect is respectfully dedicated to Dr. James F. Illingworth, to whom I am indebted for many favors.

Dicranomyia swezeyi, sp. n.

Coloration pale yellow throughout; wings yellow; cell *1st* M_2 open by the atrophy of *m*.

Female: Length, 2.8–3 mm.; wing, 3.7–3.8 mm.

Rostrum and palpi pale yellowish brown. Antennæ short, pale brown. Eyes black. Head light yellow.

Thorax pale yellow, the præscutum a little brownish. Pleura sparsely dusted with gray. Legs with the coxæ pale; femora pale brownish yellow, the tips brown; tibiæ and tarsi yellowish brown. Halteres pale. Wings pale yellow, the stigma pale brown; veins yellow. Venation: *Sc* short, ending before the origin of *Rs; Rs* moderately elongated, about one and one-half the length of the deflection of R_{4+5}; deflection of R_{4+5} strongly arcuated at origin; cell *1st* M_2 large, subquadrate, indistinctly open by the atrophy of *m;* basal deflection of Cu_1 just before the fork of *M*.

Abdomen brownish yellow, dorsal valves of the ovipositor moderately elongated and quite strongly arcuated.

Holotype, ♂, Olympus, Oahu, September 8, 1912 (O. H. Swezey).

Allotype, ♀, with the type.

This interesting little species is dedicated to its collector, Mr. O. H. Swezey, to whom I am indebted for many favors. It is apparently related to *D. foliocuniculator* Swez., but is readily distinguished by its very small size, uniform pallid coloration, and the open cell 1st M_2.

Genus **Styringomyia** Loew.

Styringomyia didyma Grimsh.

Specimens are in the collection from Honolulu taken in May, 1914. It is apparently well distributed throughout parts of Australasia.

Genus **Trimicra** Osten Sacken.

Trimicra lateralis Grimsh.

Specimens from Honolulu, April 10, 1914 (O. H. Swezey).

Genus **Gonomyia** Meigen.

Gonomyia (Leiponeura) **hawaiiensis,** sp. n.

Coloration dark brown; antennæ dark brown, the first flagellar segment light yellow; thoracic pleura striped with brown and white; wings with a pale brown tinge, longitudinal veins long and slender.

Female: Length, 3.2–3.4 mm.; wing 3.2–3.5 mm.

Rostrum and palpi dark brown. Antennæ dark brown, the first segment of the flagellum yellow. Head gray.

Mesonotal præscutum dark brown, the extreme lateral margin pale; remainder of the thoracic notum dark brown. Pleura white, with a dorsal dark brown longitudinal stripe; a ventral brown stripe occupying the sternum. Legs with the coxæ yellowish; trochanters and femora brown, the apices of the latter and the tibiæ a little darker; tarsi brownish yellow. Halteres dark brown, the knobs conspicuously light yellow. Wings pale brown, iridescent, the stigma indistinctly darker brown; veins brown. Venation: *Sc* short, ending before the origin of the sector; *Rs* long, gently arcuated; basal deflection of R_{4+5} very short; longitudinal veins beyond the cord elongated; basal deflection of Cu_1 at or before the fork of *M*.

Abdomen dark brown, the ovipositor with the dorsal valves very long and slender, slightly up-curved, dark brown at the base, horn yellow beyond.

Holotype, ♀, Koolau Mountains, Oahu, altitude 1500 feet, February, 1917 (J. F. Illingworth). Found on a wet bank.

Paratypes, ♀'s, Wailuke, Oahu, January, 1915 (O. H. Swezey); Tantalus, Oahu, October 15, 1911 (O. H. Swezey); Palolo, Oahu, February 8, 1914 (O. H. Swezey).

The type of the subgenus *Leiponeuri* Skuse (Proc. Linn. Soc. New South Wales, ser. 2, vol. 4, p. 795; 1889) is *Gonomyia gracilis* (Skuse); the name is homonymous with *Gonomyia gracilis* (Zett.)(1838) and is here renamed *Gonomyia* (*Leiponeura*) *skusei*, nom. n.

THE CALIFORNIAN SPECIES OF MALTHODES.

By H. C. Fall.

The presence of several species of Malthodes among the things which Dr. Blaisdell has asked me to study in connection with his forthcoming paper on the Coleoptera of Humboldt County, California, offers the opportunity of reviewing the Californian species of this genus in the Doctor's and my own collections, a very large proportion of which are as yet undescribed.

These delicate little things have been generally neglected by collectors, and such cabinet specimens as one runs across are too often ruined in mounting. When carefully collected and mounted, they are wonderfully interesting little creatures and offer an almost unparalleled wealth of sexual variation in the formation of the terminal abdominal segments of the male. The females are on the other hand rather monotonous in their uniformity, and are rarely distinguishable specifically except as accompanied by males. In the males themselves there are few taxonomic characters outside of the ventral sexual modifications, and this together with the fact that there is little use in attempting to give comparative measurements in insects having such fragile structure and soft integuments, is a sufficient reason for the brevity of the following descriptions, which indeed might about as well have been made still shorter.

Very little has been said in the descriptions about the females. These almost invariably differ from the males by the smaller, less prominent eyes and consequently narrower head, which is usually scarcely as wide as the thorax; by the shorter antennæ, with joints two to four more nearly equal in length, or at least with the third joint not longer than the second; by the rather more transverse thorax, and sometimes somewhat shorter elytra. The last ventral segment in this sex is rather deeply incised in the same general manner in all the species here treated.

The remarkable modifications of the abdominal apex in the male are often difficult to see in their entirety, but the form of the sixth and seventh ventrals is usually visible, and these

have therefore been selected for representation in the accompanying plate. These sketches are not drawn to any given scale, and are not to be regarded as absolutely accurate as regards relative dimensions of parts, but they are sufficiently so for the purpose they are designed to serve. A certain degree of variation has indeed been observed in these dimensions in one or two species, quite independent of any extension or contraction of the parts, which though sometimes noticeable, is less common than one would expect.

In Le Conte's latest treatment of the Lampyridæ* there is given a table of our species of Malthodes, of which three—*laticollis*, *fragilis* and *fusculus*—are accredited to California. The type of *fragilis* is from the Atlantic Coast region, and an examination of the Le Conte specimens some years ago convinced me that the Californian form so referred was not the same. This latter did not appear to be identical with any of the new species herein described. This leaves only two Le-Contean species described from the state, one of which, *fusculus*, I do not recognize in the material at hand. To these two species must be added the *M. ligulifer* described by Bergroth† from Monterey, California, and said to be related by its male sexual characters to *spado* Lec. The prothorax of *ligulifer* is said to be "nigro-piceus, anguste luteo-circumlimbatus," which does not apply normally to any Californian species known to me, and is only approached by some forms of *basalis*, near which it may be listed for the present; the terminal ventral segments of the male are, however, not defined with sufficient exactness to enable me to include it in the following table.

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* Trans. Am. Ent. Soc. 1881, p. 60.

† Ann. Soc. Ent. France (Bull. Ent. CCIII) 1889.

TABLE OF SPECIES.

1. Seventh ventral segment of male not produced, sixth broadly, not deeply emarginate, fifth broadly angulate emarginate.
   Female apterous ..... *reflexus*
   Female winged ..... *laticollis*
   Seventh ventral segment of male more or less strongly produced, sixth very broadly and deeply emarginate, fifth not emarginate.
   Seventh ventral of male rounded at tip, size large ..... *magister*
   Seventh ventral of male emarginate, notched or forked at tip 2
2. Seventh ventral of male not or scarcely more than twice as long as wide, never projecting beyond the sixth a distance as great as the length of the latter 3
   Seventh ventral segment of male much more than twice (usually three to five times) as long as wide, and projecting beyond the sixth a distance equal to or greater than the length of the latter 4
3. Seventh ventral of male deeply incised at tip, eyes very large, separated anteriorly by not more than their own horizontal width as viewed from the front ..... *vigilans*
   Seventh ventral of male broadly notched or emarginate at tip.
   Antennæ with two basal joints yellow ..... *basalis*
   Antennæ entirely fuscous or piceous.
   Eyes large and prominent, the head conspicuously wider than the thorax, thorax yellow ..... *militicus*
   Eyes relatively small, head not very much wider than the thorax, the latter piceous ..... *piceolus*
4. Seventh ventral of male with apical notch not deeper than the width of the segment at its narrowest part 5
   Seventh ventral of male more deeply forked than the minimum width of the segment 6
5. Apex of seventh ventral of male concavely beveled inferiorly, as seen in profile.
   Seventh ventral of male nearly straight in profile ..... *mollis*
   Seventh ventral of male distinctly ascending in profile, the tips more diverging as viewed vertically ..... *appendiculatus*
   Apex of seventh ventral of male simple.
   Fifth (♀) dorsal segment (♂) with a strongly produced overhanging process which is horizontally dilated and rounded at tip, broadly arched as viewed in profile; seventh ventral not bisinuate ... *obductus*
   Dorsal segments not produced apically, seventh ventral of male strongly bisinuate in profile ..... *bicurvatus*
6. Ascending portion of seventh ventral straight (in profile) and lying between long, slender, rectangularly bent dorsal processes ..... *complicatus*
   Ascending portion of seventh ventral straight, tip beveled, no slender dorsal processes, ventral segments 3 to 5 silvery sericeous at middle ..... *sericiventris*
   Ascending portion of seventh ventral sinuous or bent.
   Emargination of sixth ventral (♂) not truncate at bottom, seventh of nearly uniform width, forks parallel.
   Head (♂) much wider than the thorax, eyes large, separated in front by about their own diameter ..... *vapidus*
   Head (♂) narrower eyes smaller and separated on the front by more than 1½ times their own diameter ..... *fusculus*
   Emargination of sixth ventral truncate at bottom.
   Seventh ventral sinuate apically in profile, less widely and deeply forked ..... *tularensis*
   Seventh ventral apically bent, more widely and deeply forked .. *visceratus*

Malthodes reflexus sp. nov.

Piceous, prothorax not paler. Antennæ piceous, basal joint not appreciably paler, about reaching the elytral tips in the male, a little shorter in the female, joints 2–4 subequal, the third scarcely or barely as long as the second, the fourth only slightly if at all longer than the second, intermediate joints two and one-half times as long as wide in the male, twice as long as wide in the female. Head subequal in width to the thorax in the male, obviously narrower than the thorax in the female; eyes not very prominent, the width of the front between them fully three times that of the eye. Prothorax quite strongly transverse, sides slightly convergent from the anterior angles to the base, the margins more strongly reflexed than usual; disk biimpressed at middle, surface distinctly, moderately closely punctate. Elytra normal in the male, in the female much shorter, less than twice as long as wide, the wings entirely wanting, and the abdomen projecting beyond the elytra a distance as great as the elytral length. Length about 2 mm.

Abdominal sexual characters. The seventh ventral of the male is not produced, the genital appendages are similar in type to those of *laticollis*, the lateral processes broader basally, rapidly narrowing to the acuminate tip, which is slightly curved or everted, central piece not keeled beneath, but angularly prominent at tip superiorly, the filamentous process inferior in position; last ventral of female acutely rather deeply incised.

California. Middle coast region. 4 ♂, 5 ♀, sent by Dr. Blaisdell.

Specific localities are: Marin Co. (type ♂); Fairfax, Marin Co., V-7-11; Vine Hill, Contra Costa Co., VI-7-08; Niles Canon, V-16 (W. M. Giffard).

Very easily recognizable by the entirely piceous color, broad distinctly punctate thorax with entire side margin reflexed, simple, non-produced seventh ventral of male, and apterous female.

Malthodes laticollis Lec.

Piceous or piceo-testaceous, head darker, thorax yellow with the front angles more or less infuscate. Antennæ fuscous, basal joint paler, as long as the body in the male, second and third joints equal, fourth just visibly longer, intermediate joints about three times as long as wide. Head slightly wider than the thorax in the male, eyes moderately large, their longest diameter not much less than the minimum width of the front between them; head in the female a little narrower than the thorax, the eyes notably smaller. Thorax strongly transverse, a little more so in the female as usual, widest at the front angles, which are reflexo-incrassate, sides nearly straight and parallel posteriorly, the margin distinctly reflexed throughout; surface evidently but finely

punctate, disk biimpressed at middle, sometimes only feebly so. Length about 2½ mm.

Abdominal sexual characters. Seventh ventral of male simple and not produced; genital appendages short, consisting of two piceous slender lateral processes, hooked (abruptly bent at right angles and acuminate) at tip; a central piece, pale in color, broad at base, with a very thin laminate keel beneath and a curved terminal filamentous process.

California. Described from Santa Cruz Island. Specimens in my collection are from Riverside, Pomona, Pasadena, Mt. Wilson and San Bernardino Mts., May, July.

The abdominal characters of the male as given by Le Conte in his synopsis of the Lampyridæ (Trans. Am. Ent. Soc., 1881, p. 60), do not seem to apply to the species here described, but the fact remains that there are no males in the Le Conte collection. Two females only represent the species, the first (on the label) being the original Santa Cruz Island type, while the second—a later acquisition—is evidently a different species. Specimens of the species I have described above were carefully compared with the Santa Cruz type and are to all appearances identical.

Malthodes magister sp. nov.

Piceo-testaceous, head darker, thorax fulvotestaceous with a blackish discal spot in the type which is nearly obsolete in a second example. Antennæ entirely fuscous, passing the elytral tips in the male; joints 2–4 distinctly increasing in length, the intermediate joints fully four times as long as wide. Head (♂) distinctly wider than the thorax, eyes only moderate in size, separated in front by more than twice their own width as seen from the front. Thorax but slightly wider than long, the front angles a little prominent and reflexed, sides behind the angles narrowly margined, surface finely sparsely punctulate. Length 4.5 to 5 mm.

Abdominal sexual characters. Male: Sixth ventral deeply, broadly emarginate; seventh moderately produced, tip gradually narrowed and rounded, entire. Within the seventh ventral is a broad tongue-like process which is emarginate at tip. The terminal dorsal segments project considerably beyond the ventral at apex. Female not known.

California. Humboldt Co. The type collected at Blair's Ranch, Redwood Cr., Sept. 6, by H. S. Barber; the second example at Green Point, June 4, by Dr. F. E. Blaisdell. This is the largest species yet discovered in our fauna and is quite distinct in the male sexual characters.

Malthodes vigilans sp. nov.

Piceo-testaceous, head darker, thorax yellow. Antennæ fuscous, slightly longer than the entire body in the male, joints 2–4 increasing in length, the third however, only slightly longer than the second; intermediate joints (♂) about five times as long as wide, (♀) twice as long as wide. Head much wider than the thorax in the male, scarcely at all so in the female; eyes (♂) very large and prominent, separated in front by but little more than their own width. Thorax moderately transverse, a little more so in the female as usual, sides parallel, feebly margined, the margin just perceptibly thicker at the front angles, surface scarcely visibly punctate. Length about 3 mm.

Abdominal sexual characters. Male with sixth ventral deeply, broadly emarginate, seventh rather short and broad, projecting beyond the sixth a distance less than the length of the latter, the tip deeply narrowly incised. Last dorsal not projecting beyond the last ventral. Female as usual.

California. San Bernardino Mts., July; 2 ♂, 1 ♀, collected by the writer. The type is a male.

Malthodes basalis sp. nov.

Fuscous, front anteriorly yellow, prothorax varying from yellow with faint diffuse fuscous discal cloud, to nearly evenly fuscous with the extreme basal and apical edge yellow. Antennæ fuscous with basal two joints yellow, as long as the body in the male, joints two to four increasing slightly in length, intermediate joints about three times as long as wide. Head (♂) slightly wider than the thorax, the eyes only moderately prominent, separated in front by twice their own width or slightly less. Thorax moderately transverse, sides parallel, narrowly margined, the front angles scarcely more prominent. Length 2 to 3 mm.

Abdominal sexual characters. Male: sixth ventral deeply emarginate; seventh broad, nearly straight in profile, extending beyond the sixth a distance subequal to the length of the latter, the tip broadly emarginate; last dorsal not produced.

California. Yosemite, June 16 (W. M. Giffard), sent by Dr. Blaisdell; Licking Fork, Mokelumne River, June, (Blaisdell); Lake Tahoe, July 17-21.

Nevada. Ormsby Co., July (Baker).

Fifteen examples are before me. The type is a Yosemite male.

The bright yellow basal two joints of the antennæ will probably serve to separate this from the other California species.

Malthodes mitificus sp. nov.

Fuscotestaceous, thorax yellow. Antennæ longer than the body in the male, entirely fuscous, joints two to four distinctly increasing in length, intermediate joints about four times as long as wide. Head (♂) conspicuously wider than the thorax; eyes large and prominent, separated anteriorly by a distance not much greater than their own diameter. Prothorax moderately transverse, sides parallel, narrowly margined, front angles slightly thickened but scarcely more prominent; surface shining, minutely sparsely punctulate. Length about 3 mm.

Abdominal sexual characters. Male: sixth ventral deeply emarginate, seventh broad, extending beyond the sixth by about the length of the latter, gradually narrowed apically, the tip broadly notched; last dorsal segment not produced.

California. Mokelumne Hill. 5 ♂, sent by Dr. Blaisdell.

This species should be easily recognizable by the tabular characters. The ventral sexual structure is nearly as in *basalis*.

Malthodes piceolus sp. nov.

Piceous, elytra, body beneath and legs more or less piceotestaceous as usual. Prothorax entirely piceous except for paler basal and apical edge; mouth yellowish in some examples, not so in others. Antennæ entirely dark, fully as long as the entire body in the male, in which sex joints two to four are evidently increasing in length, and the intermediate joints fully four times as long as wide. Head a little wider than the prothorax in the male, eyes not very large, separated anteriorly by rather more than twice their own width as viewed from the front. Prothorax only moderately transverse, sides parallel or slightly convergent behind, margin narrow, slightly thickened at the front angles, surface moderately shining and very finely punctate. Length (head deflexed) 2 mm. to tip of elytra.

Abdominal sexual characters. Male: sixth ventral deeply emarginate, seventh broad, nearly parallel, passing the apex of the sixth by a distance rather less than the length of the latter, tip broadly not deeply emarginate, a little deflexed at its extremity as seen in profile.

California. Green Point, Humboldt Co., June 4-7 (Blaisdell). The type is a male.

Malthodes mollis sp. nov.

Fuscotestaceous, head blackish, thorax rufotestaceous, frequently with a more or less evident diffuse darker discal shade. Antennæ about as long as the body in the male, entirely piceous, second and third joints subequal, the fourth slightly longer; intermediate joints three to three and one-half times as long as wide. Head a little wider than the thorax in the male, the eyes not very prominent. Thorax moderately transverse, sides parallel, margin fine, not appreciably thickened at the front angles. Length about 2½ mm. to the tips of the elytra.

Abdominal sexual characters. Male: sixth ventral deeply emarginate, seventh rather broad, strongly produced, passing the sixth by nearly twice the length of the latter, gradually somewhat narrowed apically, the tip notched or narrowly emarginate, medially grooved or impressed and appendiculate each side near the base of the emargination; last dorsal not produced, broadly rounded at tip.

California. Marin Co., numerous specimens from Muir Woods, IV-23; Lagunitas, IV-25, and "Marin Co," (type ♂), all sent by Dr. Blaisdell.

Var. **longipennis** var. nov.

Two examples (♂, ♀) from Eureka, Cal. (H. S. Barber), are provisionally separated as a variety of the preceding. In the male the elytra seem slightly longer than in the typical form, or any other form known to me; the antennæ are a little paler basally, the seventh ventral of the male narrower, not medially impressed beneath at tip, the appendix therefore not double, but continuous from side to side.

Malthodes appendiculatus sp. nov.

Fuscous, thorax yellow. Antennæ (♂) attaining the tips of the wings, fuscous, basal joints paler; third joint slightly or scarcely longer than the second, fourth evidently longer, intermediate joints four times as long as wide. Head distinctly wider than the thorax, eyes rather large, separated anteriorly by a distance less than twice their width as viewed from the front. Thorax moderately transverse, sides just perceptibly converging posteriorly, margin fine, scarcely thickened at front angles. Length 3½ mm. to tip of wings.

Abdominal sexual characters. Male: sixth ventral deeply broadly emarginate; seventh rather narrow, passing the sixth by nearly twice the length of the latter, gradually narrowed for three-fourths its length, then widening, ascending and forked at tip, each fork appendiculate beneath or emarginate at tip as viewed in profile; last dorsal not produced, broadly rounded at apex.

California. "Mts. near Claremont" (Baker); Pasadena.

A single male from each locality, the first named being the type.

This species is rather closely allied to *mollis*, but differs appreciably in the seventh abdominal segment of the male, which is here narrower, curved upward at its extremity, the forks more divergent. The eyes are a little more prominent, the thorax feebly narrowed posteriorly, and there are some other slight differences which may however be constant. The genital appendages also appear to be different, but these are not very clearly visible in *mollis*. In *appendiculatus* there is a long curved central ligula narrower than the seventh ventral,

above which it lies, horizontally flattened and notched at tip, and on either side of this a very slender straight needle like process.

Malthodes obductus sp. nov.

Brownish testaceous, thorax yellowish, disc clouded with fuscous. Antennæ as long as the body in the male, fuscous, the basal joints paler; joints two and three subequal, four a little longer, intermediate joints about three and one-half times as long as wide. Head obviously wider than the thorax in the male, the eyes only moderately prominent. Thorax moderately transverse, sides straight and parallel or very nearly so, side margins fine, not thickened at the front angles. Length 2 mm. to tip of elytra.

Abdominal sexual characters. Male: fifth dorsal segment strongly produced, arched, overhanging the terminal segments, broader at tip, which is truncate with rounded angles; strongly carinate beneath except at apex, which is concave; sixth ventral deeply, broadly emarginate; seventh strongly produced, deeply notched at apex, in profile bent upward a little at about apical third, the tip again horizontal.

California. Green Point, Humboldt Co., June 4-7 (Blaisdell); Washington, Seattle (Prof. O. B. Johnson).

The type is a male from the first named locality.

In the typical form the apical notch of the seventh ventral is as deep as the terminal width of the segment. In the Seattle males the segment is more deeply cleft, the forks more diverging and the tip of the produced fifth dorsal is a little different. These may represent a closely allied species, but as the sexual modifications are of the same type throughout, I prefer to consider it a varietal form.

Malthodes bicurvatus sp. nov.

Fuscotestaceous, thorax entirely yellow, head piceous. Antennæ as long as the body in the male, fuscous, scarcely paler basally in fully colored specimens; third joint slightly or scarcely longer than the second, fourth distinctly longer than the third, intermediate joints about four times as long as wide. Head evidently but not greatly wider than the prothorax, eyes only moderately prominent. Thorax moderately transverse, sides straight, finely margined, front angles not thickened. Length (head deflexed) about 2 mm. to tips of elytra.

Abdominal sexual characters. Male: last visible dorsal segment broadly truncate, the lateral angles produced downward and backward in a rather broad process which is dilated and rounded at tip. Sixth ventral broadly deeply emarginate, the curvature becoming more narrowly parabolic at the bottom of the emargination; seventh ventral narrow, elongate, notched at tip, bisinuate in profile, with a short tooth-like process at middle of upper side.

California. Mokelumne Hill, April (Blaisdell), type ♂; Adams Springs, Lake Co., June 18 (Blaisdell).

Malthodes complicatus sp. nov.

Fuscotestaceous, head piceous, thorax entirely yellow or with the extreme margin at apical angles infuscate. Antennæ longer than the body in the male, entirely fuscous, second and third joints subequal, fourth evidently longer, intermediate joints more than four times as long as wide. Head (♂) wider than the prothorax, eyes moderately prominent. Prothorax moderately transverse, sides parallel and narrowly margined, margin not appreciably thickened at the front angles. Length (head deflexed) 2¼ mm. to tips of elytra.

Abdominal sexual characters. Male: last (?) dorsal with a slender descending lateral process, which is abruptly bent at right angles, the terminal portion horizontal. Sixth ventral deeply, broadly emarginate, the bottom of the emargination truncate; seventh ventral received between the descending dorsal processes, elongate, narrow, forked rather deeply at tip, obliquely ascending in profile in its apical two-thirds.

California. Pomona, March 25 (type ♂); Pasadena; Claremont (Baker); Santa Barbara, Feb. 4; Ojai Valley, March 5.

Superficially closely resembling the preceding species, but very distinct by the sexual characters.

Malthodes sericeiventris sp. nov.

Fuscotestaceous, head piceous, thorax entirely clear yellow. Antennæ as long as the body in the male, entirely fuscous, joints two to four visibly increasing in length, intermediate joints nearly five times as long as wide. Head (male type) notably wider than the thorax, with prominent eyes; less wide in a second male. Thorax moderately transverse, sides straight and nearly parallel, side margins fine, not appreciably thickened at the front angles. Length (head deflexed) 2½ mm.

Abdominal sexual characters. Male: ventral segments 3 to 5 silvery sericeous at middle throughout their length; sixth deeply emarginate; seventh elongate, narrow, deeply divergently forked apically, in profile obliquely ascending in about its apical half, the tips of the forks thickened and concavely beveled.

California. Pomona, April 25-May 20; 2 ♂, 2 ♀; type ♂.

The sericeous ventral area of the male is quite unique and has the appearance of an excessively short and dense silvery pile, but it is not resolvable, as such by a ¼ inch triplet, and is probably due to surface sculpture.

Malthodes vapidus sp. nov.

Fuscotestaceous, head piceous, thorax yellow. Antennæ entirely fuscous, as long as the entire body in the male; joints two to four increasing in length, intermediate joints four times as long as wide. Head much wider than the thorax, the eyes large and prominent, separated anteriorly by not more than their own diameters. Thorax moderately transverse, sides straight and nearly parallel, side margins very fine, not thickened appreciably at the front angles. Length (head deflexed) about 2 mm. to tips of elytra.

Abdominal sexual characters. Male: last dorsals not produced; sixth ventral deeply broadly emarginate; seventh ventral rather wide, parallel sided, deeply widely divided at apex, sinuately ascending in profile.

California. Lake Tahoe, July 17-21, '97 (type ♂).

Malthodes fusculus Lec. Proc. Acad. Nat. Sci. Phila. V, p. 346.

Le Conte's description, Synopsis of Lampyridæ, Trans.. Am. Ent. Soc., IX, 1881, is as follows:

"Last ventral (♂) bent in a sinuate manner obliquely upwards and more deeply nicked at tip than in *fragilis;* prothorax transverse, finely margined, tinged with testaceous; head black, eyes large, prominent, antennæ long, slender, fourth and following joints longer than the second or third, ♂ two-thirds, ♀ one-half as long as the body. Length 3 mm. Cal."

A variety is mentioned with the prothorax "yellow testaceous ♀."

While probably most closely related to *vapidus*, this species is at once separable by the much smaller eyes and consequently narrower head, which is not very much wider than the prothorax. The last ventral is forked in a similar manner, but the emargination is much less deep than in *vapidus*, the depth being subequal to the width of the segment at the bottom of the emargination, while in *vapidus* it is much deeper than the segmental width at this point. In *fusculus* the forks comprise not more than one-fourth the entire length of the segment, in *vapidus* about one-half the length of the segment.

The type was taken at or in the vicinity of San Francisco.

Malthodes tularensis sp. nov.

Fuscous, thorax yellowish, more or less tinged with fuscous, especially along the side margins. Antennæ entirely fuscous, as long as the body in the male; third joint scarcely longer than the second, fourth evidently longer, intermediate joints four times as long as wide.

Head evidently wider than the thorax, eyes moderately prominent. Thorax quite strongly transverse, sides straight and parallel, rather strongly margined. Length (head deflexed) 2¼ mm. to tips of elytra.

Abdominal sexual characters. Male: sixth ventral very deeply, broadly emarginate, the emargination truncate at bottom, seventh narrow, very elongate, polished, yellow, very sparsely pubescent, gradually narrowed for two-thirds its length, then widened and deeply forked; as viewed in profile, horizontal in rather more than basal half, then rather abruptly sinuately ascending; last dorsal not produced.

California. Tulare Co., June 25, 2 ♂, 1 ♀. Type ♂.

Malthodes visceratus sp. nov.

Fuscous or fuscotestaceous, thorax yellow with side margins more or less infuscate. Antennæ entirely fuscous, as long as the body in the male, third joint but slightly longer than the second, fourth a little longer, intermediate joints fully four times as long as wide. Head (♂) not much wider than the thorax, narrower than the thorax in the female. Thorax strongly transverse in both sexes, sides nearly straight and parallel, strongly margined, the margin thickened at front angles. Length 2 to 2½ mm.

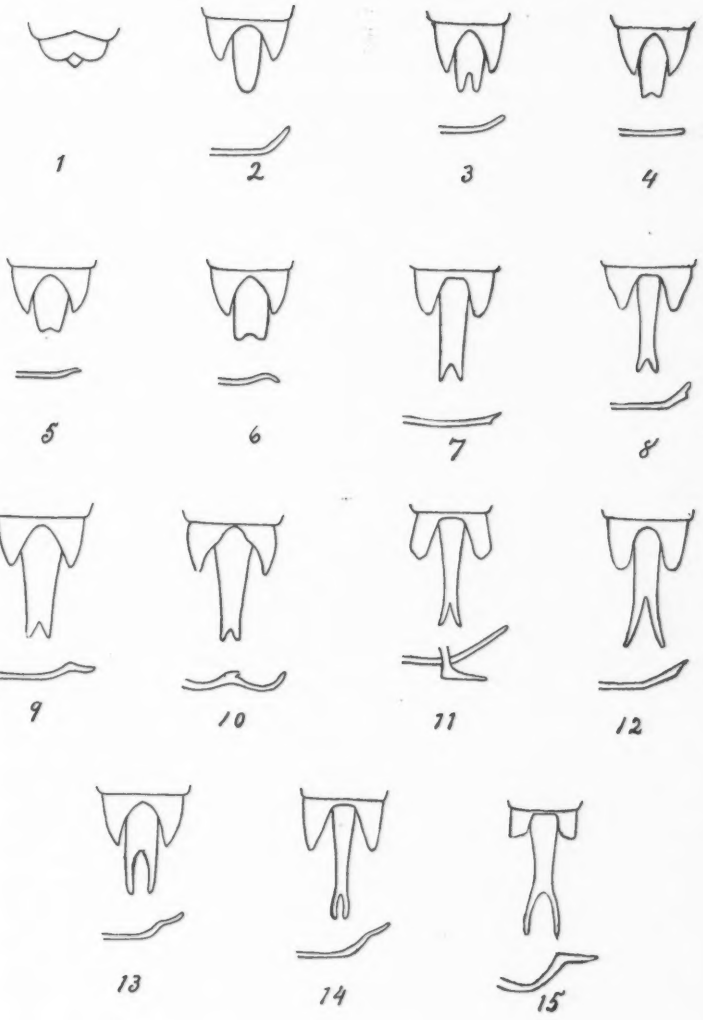
Abdominal sexual characters. Male: sixth ventral broadly, deeply emarginate, the emargination truncate at bottom; seventh elongate, deeply, broadly divided at apex, the forks slender, strongly up-curved basally in profile, then bent suddenly in horizontal direction; sixth (?) dorsal acutely projecting downward at sides to enclose the last ventral.

California. Mill Valley, III-3-'07 (type ♂); Mt. Tamalpais, V-1-'13; Green Point, Humboldt Co., VI-5-'16; Mariposa Co., VI-16 (W. M. Giffard), all from Dr. Blaisdell.

EXPLANATION OF PLATE III.

All figures show the outline of the sixth and seventh ventral segments of the male, and beneath them in each case, except Fig. 1, the seventh ventral as viewed in profile. In *complicatus*, Fig. 11, is shown also one of the downward projecting dorsal appendages, between which the seventh ventral lies.

Fig. 1. Terminal ventral segments of *Malthodes reflexus* and *laticollis*.
Fig. 2. Same of *magister*.
Fig. 3. " *vigilans*.
Fig. 4. " *basalis*.
Fig. 5. " *mitificus*.
Fig. 6. " *piceolus*.
Fig. 7. " *mollis*.
Fig. 8. " *appendiculatus*.
Fig. 9. " *obductus*.
Fig. 10. " *bicurvatus*.
Fig. 11. " *complicatus*.
Fig. 12. " *sericeiventris*.
Fig. 13. " *vapidus*.
Fig. 14. " *tularensis*.
Fig. 15. " *visceratus*.



H. C. Fall

NOTES ON THE REPUGNATORIAL GLANDS OF CERTAIN NOTODONTID CATERPILLARS.

GLENN W. HERRICK and JOHN D. DETWILER.

In the course of a study which the writers are making of the life histories and habits of the red-humped apple caterpillar (*Schizura concinna*) and the yellow-necked caterpillar (*Datana ministra*), the junior author noted that while handling the caterpillars of the former species, especially when they were pinched with forceps, a considerable amount of moisture would suddenly appear in an area about the body of the larva as it lay in the hand or rested upon the table. Curiosity as to the source of the moisture was aroused and the following experiments were made by the writers to determine its origin, nature, and method of dispersion.

The presence of repugnatorial eversible glands in Notodontid caterpillars has been known since the time of DeGeer, and Packard* gives a list of nine species in which the glands have been found. *S. concinna* appears in the list and Packard remarks as follows concerning it.

"While examining the very gaily colored and heavily spined caterpillars of *Schizura concinna*, I observed that when a fully grown one was roughly seized with the forceps or fingers it sent out a shower of spray from each side of the prothoracic segment, exactly like that of *Cerura* and *Macrurocampa*." Several years previously a note from C. S. Denham† appeared in Insect Life in which he said that in rearing a brood of these caterpillars he "discovered that they had the power to emit quite a quantity of strong hydrochloric acid strong enough to be decidedly corrosive to the skin and easily perceptible in the atmosphere."

In investigating the source and nature of the moisture which appeared whenever the Schizura larvæ were handled at all roughly it soon became evident that these caterpillars possessed considerable amounts of the liquid and that they were able to eject it to a surprisingly long distance and over a comparatively large area. In determining the habits and behavior of the different individuals of *Schizura concinna* in ejecting the liquid

* Jr. N. Y. Ent. Soc., Vol. III, pp. 110–127, 1895.
† Insect Life, Vol. I, p. 143, 1888.

the caterpillars were placed on large sheets of blue litmus paper and were then irritated at different points on the body by pinching them with forceps. It was difficult to see the spray on account of its fine misty quality. Occasionally, by getting the caterpillar in just the right position between the observer and the rays of light, one could see a tiny jet or cloud of mist. The effect on litmus paper, however, was instantaneous and conspicuous, for every drop that touched the paper changed it to a characteristic red color. Moreover, the area covered by the spray and the distance to which it could be ejected were easily and accurately determined. The following experiments and observations on *S. concinna* illustrate the action of the glands.

A full-grown larva was carefully placed near the center of a large sheet of litmus paper. While in this position it was pinched with tweezers on the fifth abdominal segment. At once a fine invisible spray was thrown out around the body in a posterior direction. An area surrounding the body about 3 inches wide and 5 inches long was colored solidly red, while about the lateral and posterior borders of this solidly colored area was a field covered with drops of various sizes. From right to left the farthest drops were 5½ inches apart.

The larva was pinched again near the thorax, the main pressure being exerted on the right side of the body. There was an immediate spray toward the right and in a posterior direction. The farthest drop posteriorly was 7½ inches from the caudal end of the abdomen, while the farthest drop laterally was 5¼ inches from the body. Figure 1 shows the pattern of the spray on the litmus paper.

An attempt was made to determine the direction of the spray in relation to the point of irritation. When irritated on the right side and the head left free, the head is thrown to the right and the spray is directed largely to the right side of the body. When irritated on the left side the movement of the head is in that direction and the spray is directed mostly to the left. When irritated near the posterior end of the abdomen there is a decided tendency for the spray to be thrown in a posterior direction. When pinched just behind the hump on the second thoracic segment all of the secretion was projected backward and to the left. In case of this particularly vigorous larva the drops were thrown approximately 7 inches distant in a lateral direction from the head and in a posterior direction

to the distance of 7½ inches. Again the larva was touched lightly on the right side of the body. The head was immediately turned to the right whereupon a sudden pinch with forceps caused the liquid to be projected in a fine spray almost entirely on the right side of the body. In all, this larva was irritated seven distinct and successive times. It responded to each of the first six irritations by an ejection of liquid although in a lesser quantity toward the end, while no response was obtained from the seventh irritation. Evidently the supply became exhausted or the larva became fatigued and indifferent to the irritation.

Fig. 1. Spray pattern (½ size), reproduced from litmus paper, of one ejection of liquid by a vigorous larva. C, position of caterpillar.

Since the direction of the spray appeared to correspond to the direction in which the head was free to move we obtained a fresh larva and held the head so that there was practically no movement to the right or left. In response to stimulus under these conditions the larva was still able to throw a spray of the liquid to the distance of from 6 to 7 inches, but wholly in a posterior direction over the entire body. This experiment was repeated with another larva with similar results. It appears evident that the caterpillar can direct the liquid backward to a distance of several inches even though the head be prevented from free movement to the right or left. Moreover, experiments show that the larva can project the spray in an anterior direction.

The caterpillars under observation were too far advanced to determine whether the larvæ possess functional glands in all of the earlier instars. A late brood, however, was found in which the larvæ were in the next to the last instar. One of these larvæ, after what seemed to be a greater degree of irritation than usual, did eject a considerable quantity of the fluid, the farthest drop falling at a distance from the body of about 3¼ inches. We hope to be able, next season, to make further investigations of this phase of the subject.

The opening of the gland is a narrow transverse slit on the ventral side of the prothorax close to the cephalic border of this segment. The gland is sack-shaped and situated within the thoracic cavity. It appears to be quite similar to the corresponding gland in *Cerura vinula* described by Klemensiewicz.* Further detailed description of this gland and its morphology will be presented by the Junior author in a later paper.

Regarding the chemical nature of the secretion it is sufficient to say here that it gives a marked acid reaction with blue litmus paper and that it has a pungent and characteristic odor that immediately suggests acetic acid. The subject is under careful investigation in conjunction with Professor E. M. Chamot of the chemical department, the results of which will be given in a later paper. Suffice it to say, the investigations indicate that the secretion is formic acid. Poulton† has already shown that the secretions from the similar gland in *Cerura vinula* is formic

* Verhandlungen d. Zool. Bot. Gesellsch in Wien. Vol. 32, pp. 468–474, 1882.
† Trans. Lon. Ent., Soc. for 1886, p. 157.

acid. The effect of the fluid on the skin is such as to cause burning and itching similar to the effect of the common plant known as "nettles." However, this effect is not so noticeable unless the quantity falling on the hand is of considerable amount.

It is hoped that opportunity may be found next year for further observations and experiments on these glands in other members of the genus.

The authors desire to express their acknowledgment to Miss Ellen Edmonson for her careful reproduction of the spray pattern in Figure 1.

NOTES ON THE IMMATURE STAGES OF DELTOMETOPUS RUFIPES MELS. (Coleoptera, Eucnemidæ).*

EDNA MOSHER.

Larvæ of the family Eucnemidæ have been somewhat of a puzzle to entomologists since the first description of a larva of Fornax by Coquerel in 1856. The first American species were described by Osten Sacken, from larvæ collected by Dr. Horn and an unnamed species from his own collection. The larvæ are found in dead wood, some of them where it is still very firm, others, including the species under discussion, prefer wood which is more decayed. Although living in the wood, they differ very materially from the ordinary type of wood-boring insects for they have no powerful mandibles such as these insects are provided with. Instead the head strongly resembles that of the leaf-mining larvæ without having even as efficient mandibles as they. Schiodte quotes Coquerel as saying that they are "without perceptible organs of the mouth—nay without a buccal orifice." It has been doubted by some authors, including Schiodte, that they were able to make their own burrows and were suspected of living in burrows made by other insects. The same authors also differed as to the food of such larvæ, considering their lack of mouthparts, and Schiodte seemed certain that they must feed on xylophagous larvæ and pupæ, since it was quite evident they could not feed on wood. Some have thought they lived on the sap or "juices of the wood." Little has been added to our knowledge of the larvæ or pupæ since Osten Sacken's paper was written. Since these larvæ seemed to be such an entomological puzzle, I have been much interested in collecting them from time to time in the last five years. Altogether three species have been collected, but only one or two specimens each time, and all my attempts at rearing them have been unsuccessful. Mr. H. G. Crawford, however, found one of these species very abundant at Guelph, Ontario and succeeded in rearing a number of adults. I am greatly indebted to him for placing all of his material at my disposal, and also to Mr. Charles Dury, of Cincinnati, who identified the species for me as *Deltometopus rufipes* Mels.

* Contributions from the Department of Zoology and Entomology, Ohio State University, No. 56.

LARVA: The larva is depressed, somewhat moniliform, pale yellow in color, with dark brown on the head, prothorax and ninth abdominal segment. When full-grown it averages 14–16 mm. in length, or when fully expanded, as much as 18 mm. The head is subtriangular in outline, heavily chitinized and nearly all dark brown as shown by the stippled portions in Figs. 1 and 2. The pale lines seen on either side of the head capsule (Figs. 1, 2, 3, 4) may indicate sutures, as the head capsule will break along these lines when softened. If they are sutures, their homology is doubtful; but as they are furrows on the ectal surface and ridges on the ental they are perhaps for the attachment of muscles. The head is much thinner cephalad and laterad of these lines. Along the cephalic margin of the head capsule are two small triangular projections and four similar, but larger ones, along the lateral margin, making it serrate. The lateral margin also has a prominent blunt projection caudad of the serrations. The head is inserted into the prothorax and may move laterad until this blunt projection strikes the dark brown protuberance on the prothorax. The head may also be moved dorsad and ventrad, and a prominent projection like a condyle on the meson of each caudal margin seems to facilitate these various movements and also prevents the head from being shoved farther back into the prothorax. The very dark line extending caudad from each cephalic projection (Figs. 3 and 4, t) marks the attachment of a strongly chitinized bar to each surface, which is probably the tentorium. Between these two bars at the cephalic end of the head is an opening, the entrance into the buccal cavity. There are no ocelli present. The head capsule is sparsely covered with very minute setæ. The appendages of the head are all retractile. Their location is indicated in Fig. 3, where they are shown extruded. Normally only the extreme tips of the mandibles are visible and then only under high power, as all of these structures are exceedingly minute. What I have considered the antenna (Fig. 5) looks very like a maxilla but does not seem to be in any way connected with the buccal cavity. Its median projection at the distal end seems to be covered with sensory structures and the lateral projection ends in at least three finger-like projections. The structures articulated to the tentorial bar are certainly the mandibles (Figs. 6 and 7, md). Each moves in a horizontal plane and has one very long tendon.

Mesad of these are a group of structures which seem to be maxillæ and labium but these can only be seen distinctly under the oil immersion lens. The median portion, which is pointed at the end (Figs. 3 and 8, lb) has a longer, sharp projection on either side which appears to be two-segmented. The dorsal surface of this structure (Fig. 8) shows a long tube connected with the median projection which I have traced back into the prothorax and may be the alimentary canal, although it is very small and the salivary duct should open here. The tube seems to have a chitinous lining, however. Laterad of these structures and slightly dorsad of them are what appear to be maxillæ. The distal end bears a cluster of projections which appear to be arranged in a circle. These structures are only a little less strongly chitinized than the mandibles. There has been so little morphological work done on this type of head that one is rather at a loss to account for their peculiar structure and extremely doubtful as to the homology of parts.

The entire surface of the thorax and abdomen is very finely striate, except when otherwise indicated, and all the body segments are very similar, except that the thoracic segments are shorter in proportion to their width than those of the abdomen. There are no traces of legs or prolegs. Each segment except the caudal one has some very distinct areas which appear velvety under a low power lens as if densely covered with fine setæ. On the dorsal surface of the prothorax this area is triangular and located near the caudal part of the segment but on the other thoracic segments it is cephalic and somewhat triradiate. The areas are ovate on the abdominal segments and located near the cephalic margin. The areas are the same shape on the ventral surface except that the median projection is lacking on the mesothorax and metathorax. These areas are really covered with scales as shown much enlarged in Fig. 11, and a few fine setæ are also present. Caudad of these velvety areas on the mesothorax and metathorax, on both surfaces, are much coarser striations than on the remainder of the segment. Near the caudal margin of each body segment except the prothorax and the last abdominal segment on both surfaces, and the eighth segment on the dorsal surface, is a clear, smooth area clearly outlined by a fine, slightly elevated, brown, chitinous ring. These are almost semicircular in outline on all segments except the ventral surface of the eighth abdominal, where it is much

smaller. The ninth abdominal segment is apparently the last one, although the portion surrounding the anal opening probably represents the tenth segment. It is outlined and almost covered with coarse, triangular spines. The remainder of the ninth segment is sparsely covered with very minute setæ. On both surfaces the heavily chitinized caudal portion is punctate. At the caudal end of this segment are two minute spines. The spiracles are easily visible on the lateral part of the mesothorax and first eight abdominal segments (Fig. 9). In the spiracular region are a number of structures which seem to be olfactory pores. The arrangement is shown on one segment in Fig. 9 and several very much enlarged in Fig. 10. These seem to be all of the simple type as shown in McIndoo's Fig. 19. A few sensory pores were also located on the head, and what appeared to be a compound one with several openings was found on each side of the ventral surface of the prothorax. These show as a round white spot on the large, brown area on each side of the meson. Nearly all of the body segments have a small, lateral projection which seems to aid in locomotion, as the larva moves on either side as well as on either dorsal or ventral surface.

PUPA: The pupa (Figs. 12 and 13) is very much like that of an elaterid and does not differ in essential details from any other coleopterous pupa. The entire body, including appendages, is densely covered with very fine pubescence. In dorsal view (Fig. 12) a small portion of the head is visible and the thoracic and nine abdominal segments clearly defined. A deep furrow between the thorax and abdomen allows for considerable movement. The caudo-lateral angles of the prothorax are produced for at least one-fourth the total length of the segment. The first eight abdominal segments bear spiracles but those of the first, and sometimes those of the eighth, are concealed. The lateral margin of each abdominal segment is more flattened than the remainder and separated from it by a slight furrow as indicated by dotted lines. There are many long, soft setæ on the various body segments as indicated in the figure, the row on the base of the mesothoracic wings being quite prominent. In ventral view (Fig. 13) it will be seen that none of the head sutures are visible, the antennæ are closely approximated and mandibles, maxillæ and labial palpi are easily distinguished. The prosternal spine and its groove on the mesothorax are easily seen and all of the appendages are quite normal in

arrangement. A portion of the seventh segment is elevated and extends as a flap over a portion of the eighth when the body is curved. The elevated portion containing the anal opening is probably the tenth segment. Figs. 12 and 13 show a female pupa. The arrangement of the caudal segments is somewhat different in the male as shown in Fig. 14. The length of the female averages 8 mm., the male 6 mm. The color is white until the color of the developing beetle begins to show when it appears to be a dull brown.

This species apparently takes three years to mature, as larvæ of three different sizes have been taken in the same log in autumn. The larvæ are certainly able to bore into wood. They seem to use the serrate margin of the head to assist progress and probably hold themselves firmly in a partially-formed burrow by the lateral protuberances on the segments, especially the strongly chitinized one on the prothorax. The burrows are very small and not easily detected, but some of the wood where they were found did not need much boring as the larvæ could almost push their way along. As to their food, I cannot state positively, but they have always refused any insect larvæ placed in the cages, and have lived for at least eight consecutive months on nothing but wood. In the case of larvæ feeding in very firm wood there never seems to be any "sawdust" or frass about, but very frequently a clear liquid is seen to be expelled from the anus. Even such facts as have been discovered about the mouth-parts will not entirely solve the problem.

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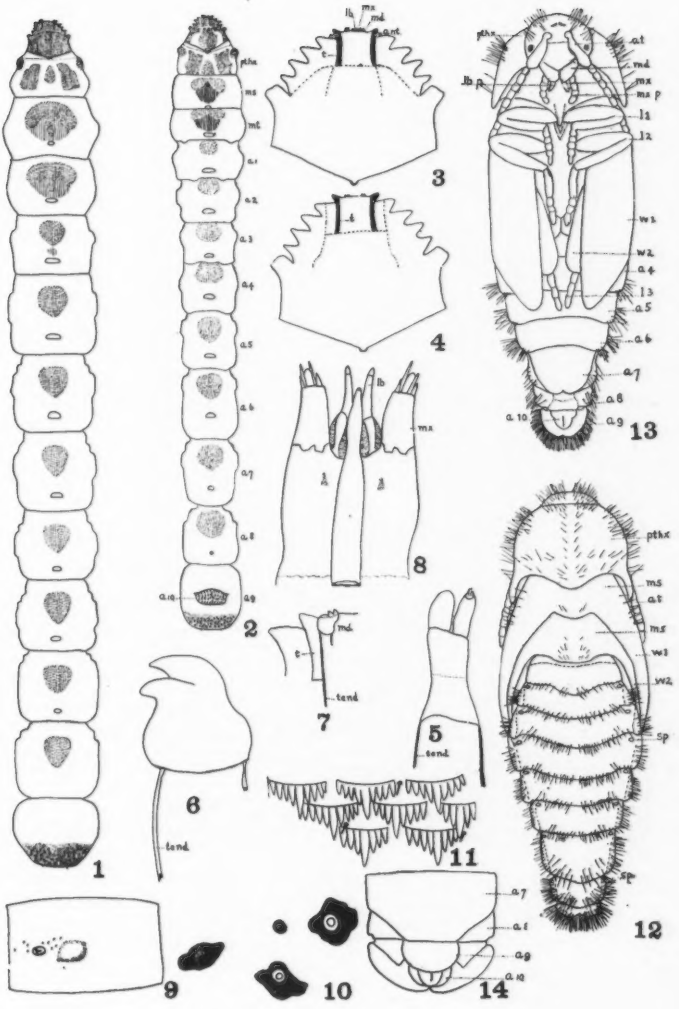
EXPLANATION OF PLATE IV.

Fig. 1. Dorsal view of larva with all the segments extended to their full length, as when the larva is in motion.
Fig. 2. Ventral view of larva, with some of the segments retracted as they appear when the larva is inactive and in most alcoholic specimens, (drawn to slightly smaller scale).
Fig. 3. Dorsal view of head showing mouth-parts extruded.
Fig. 4. Ventral view of head showing mouth-parts retracted.
Fig. 5. Dorsal view of antenna and tendons.
Fig. 6. Mandible and tendons.
Fig. 7. Showing articulation of mandible.
Fig. 8. Dorsal view of labium and maxillæ.
Fig. 9. Lateral view of fourth abdominal segment showing location of spiracle and sensory pores.
Fig. 10. Several sensory pores greatly enlarged.
Fig. 11. Arrangement of scales on "velvety" areas.
Fig. 12. Dorsal view of female pupa.
Fig. 13. Ventral view of female pupa.
Fig. 14. Ventral view of caudal segments of male pupa (without setae).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Edna Mosher

RESOLUTIONS ON THE DEATH OF DR. S. W. WILLISTON.

Dr. Samuel Wendell Williston, who was an early member and fellow of this society and was elected an Honorary Fellow in 1916, died in Chicago, Ill., August 30, 1918. He was born in Boston, Massachusetts, July 10, 1852, and had achieved an almost unique position in American Science for the present period in that he had attained distinction in at least three branches of biology.

His interest in entomology was centered mainly in the Diptera in which group he was an ardent worker, an extensive contributor and his influence probably second to no other American entomologist.

Aside from his standing in American entomology his host of friends in all branches of science will remember him most affectionately as a man of the finest human qualities and as a striking example of the possibilities of achievement open to the American youth of high ideals and devotion to science.

The Entomological Society of America desires to place on permanent record its appreciation of his earnest and hearty support of the society, his many and valuable contributions to entomology, his standing as a representative of the best in American science and his loyal friendship and manhood.

Committee: HERBERT OSBORN,
T. H. PARKS,
J. J. DAVIS.

SAMUEL WENDELL WILLISTON

Honorary Fellow, Entomological Society of America

Courtesy of Sigma Xi Quarterly

PROCEEDINGS OF THE ENTOMOLOGICAL SOCIETY OF AMERICA.

The Thirteenth Annual Meeting of the Entomological Society of America was called to order by the Secretary in Room 9, Gilman Hall, Johns Hopkins University, Baltimore, Md., at 1:20 P. M., December 26, 1918.

The President and Vice-Presidents being absent, Dr. T. J. Headlee was elected President pro tem. He appointed the following committees:

AUDITING: H. A. Gossard, G. A. Dean, F. M. Gibson.

NOMINATING: W. E. Britton, W. A. Riley, J. M. Aldrich.

RESOLUTIONS: Herbert Osborn, T. H. Parks, J. J. Davis.

The Chair also appointed the following temporary members of the Executive Committee, to replace absent ones: Jas. G. Needham, E. P. Felt, J. G. Sanders, A. F. Burgess, E. D. Ball.

The meeting then adjourned until 9:00 A. M., December 27.

December 27, 1918.—The meeting was called to order at 9:00 A. M. by President pro tem Headlee, in the same room as before.

The Executive Committee submitted the reports of officers, and the following report of their own:

Your Executive Committee has elected within the year the following members:

On May 1:

PROF. MARIO BEZZI, Turin, Italy.
E. H. BLACKMORE, Victoria, B. C.
E. L. CHAMBERS, Seville, Ohio.
T. N. HUBBELL, Ann Arbor, Mich.
R. F. HUSSEY, Ann Arbor, Mich.
JOS. C. OUELLET, Outremont, Que.
LADISLAV SASKO, Chicago.
FRANK N. WALLACE, Indianapolis, Ind.
WM. LUNDBECK, Copenhagen, Denmark.

On December 26:

O. G. BABCOCK, Dallas, Texas.
A. J. BASINGER, Columbus, Ohio.
H. M. BRUNDRETT, Houston, Tex.
A. N. CAUDELL, Washington, D. C.
A. G. DUSTAN, Fredericton, N. B.
J. E. EYER, Camp Sherman, Ohio.
W. O. HOLLISTER, West Lafayette, Ind.
A. C. KINSEY, Forest Hills, Mass.
H. P. KLOTZ, Woodmere, Long Id.
WM. M. MANN, Washington, D. C.
J. B. PARKER, Washington, D. C.
T. H. PARKS, Columbus, Ohio.
FRED W. POOS, JR., Charlottesville, Va.
THOS. E. B. POPE, Milwaukee, Wis.
MAX H. RUHMANN, Vernon, B. C.
RAYMOND C. SHANNON, (Life Member), Washington, D. C.
RALPH M. SMITH, Twin Falls, Idaho.
OLIVER I. SNAPP, Agr'l College, Miss.
WM. B. TURNER, Hagerstown, Md.
R. H. VAN ZWALENBURG, Hagerstown, Md.
DON C. WARREN, AUBURN, Ala.
L. P. WEHRLE, Ithaca, N. Y.
A. D. WHEDON, West Chester, Pa.

Total, 32.

We have re-elected Herbert Osborn as Managing Editor of the ANNALS, and have elected the following members of the Editorial Board: J. G. Sanders, Wm. M. Wheeler, E. M. Walker, to serve for three years. T. D. A. Cockerell has resigned.

We have re-elected Nathan Banks and A. D. MacGillivray to succeed themselves in the Thomas Say Foundation.

We beg to submit the following recommendations:

First, that in future a time limit of fifteen minutes be placed on papers in our programs, subject to extension by vote of the Society at time of reading.

Second, that one year's dues be remitted to each of our members who has served in the present war in the army or navy of the United States or an allied power; provided, that if such service in any case has been for a longer period than one year, then the remission shall extend to the full period.

Third, that the dues of M. C. Tanquary be remitted for the three years in which he was engaged in Arctic exploration as a member of the Crocker Land Expedition, as a recognition of his gratuitous services to science.

T. J. HEADLEE, *Chairman.*

The report was adopted, including the recommendations.

The accompanying reports were as follows:

REPORT OF THE SECRETARY.

The year's record is distinctly encouraging. Our membership has almost held its own in spite of war; our permanent funds have nearly doubled, including noteworthy gifts from two of our oldest and most honored members; our current income is but slightly below that of last year, which was the largest in our history; and the ANNALS has withstood the rising cost of printing and maintained its high reputation.

The following members have died since the last report:

S. W. WILLISTON, Honorary Fellow.
FREDERICK KNAB, Fellow and charter member.
W. HAGUE HARRINGTON, charter member.
C. A. HART, charter member.
THOMAS P. LUCAS.
VERNON KING, aviator, killed in action.
V. A. E. DAECKE, charter member.

The following have resigned:

H. E. CRAMPTON
M. M. HIGH
H. E. SCHRADIECK
F. E. WATSON
M. A. YOTHERS
S. MARCOVITCH

Thirty-five have been dropped for non-payment of dues.

On Dec. 23rd the membership was in the following classes, as far as the payment of dues is concerned:

(American Members, including Hawaiian.)	
Paid for 1918	432
Owing for one year	63
Owing for two years or more	46
(Foreign)	
Paid for 1918	12
Owing for one or more years	20
Total	573
Elected this meeting	21
Actual present membership	594

One year ago I reported 386 members fully paid up, which was probably the highest record for the Society at the time; we now have (counting foreign) 444, which shows how splendidly the members have rallied to our support in war time.

In sending out the annual statements, the Secretary took occasion to suggest that members, nearly all of whom in the United States are now holding bonds of the government, might deposit a fifty-dollar bond in payment for life membership. Four members did this, and two honorary fellows, J. H. Comstock and E. A. Schwarz, each donated a bond of the same amount. Other members indicated an intention, and some a hope, of becoming life members in the near future. It is desirable to keep this matter before the attention of members until after the next loan is subscribed. The result has been encouraging, but should be larger.*

In October, when much of the business of the country was depressed by the wave of influenza, the Secretary received a circular from the Permanent Secretary of the American Association for the Advancement of Science, in which it was announced that the plans of the Association for the Baltimore meeting were much embarrassed, by reason of an unexpected shortage of meeting rooms in Baltimore, the prevailing influenza epidemic, the general war conditions, and the railroad and hotel congestion. This circular suggested that affiliated societies cut down their meetings to the transaction of necessary business and the consideration of problems urgently important for the winning of the war. In view of the fact that the Association of Economic Entomologists, our sister society, might be expected to take care of urgent entomological problems, the Secretary, in transmitting copies of the circular to members of our Executive Committee, took occasion to recommend the abandonment of our program as our logical duty in the premises. The Executive Committee immediately agreed, and announcement was made of this change from our regular policy. Later developments, especially the armistice and the cessation of influenza, so far relieved the situation that I believe we all wish we were to have a program. The decision of the Executive Committee, however, should be viewed from the standpoint of mid-October. No precedent has been established, and the suggestions adopted by our present business session will without doubt operate to give us a better program for next year than we have usually had.

Respectfully submitted,

J. M. ALDRICH, *Secretary.*

* Since the meeting E. D. Ball, G. C. Crampton and J. F. Illingworth have become life members.

TREASURER'S REPORT.

CURRENT ACCOUNT.

RECEIPTS.

Balance on hand (Annals, XI, 101)	$ 303.99
Dues of Members	914.56
From Managing Editor of Annals	485.89
Interest on current account	8.49
Exchange on checks	.40
Total	$1,713.33

DISBURSEMENTS.

Annals for December, 1917	$ 303.51
Engraving for Annals	100.27
Clerical work on Annals	46.80
Printing, Secretary's office	27.25
Postage and stationery, same	23.00
Clerical assistance, same	37.00
One membership diploma	.25
Balance in banks (excluding $2.74 in permanent fund)	1,171.25
Total	$1,713.33

Our present large balance is due to the fact that we have not yet received bills for the last four numbers of the ANNALS.

PERMANENT FUNDS.

On hand last report (Annals, XI, 102)		$273.06
Eugene Amandus Schwarz, gift		50.00
John Henry Comstock, gift		50.00
Wm. T. Davis, life membership		50.00
Howard Notman, life membership		50.00
R. C. Shannon, life membership		50.00
J. M. Aldrich, life membership		50.00
Interest, Cleveland Trust Co.		11.02
Interest on bonds	$3.70	
Less accrued interest paid	1.60	
		2.10
Increase in value of War Savings Stamps since purchase		.40
Total		$586.58

SECURITIES HELD.

Government Bonds—	
First Liberty Loan converted—No. 414,847	$ 50.00
Second Liberty Loan converted—No. 1,784,246	50.00
Third Liberty Loan:	
No. 2,538,965	50.00
No. 2,923,933	100.00
No. 2,923,934	100.00
Fourth Liberty Loan:	
No. 4,714,709	50.00
No. 6,951,394	50.00
No. 490,434	100.00
Total	$550.00
War Savings Stamps, present value, eight Stamps, at $4.23	33.84
Cash to balance, carried in current account	2.74
Total	$586.58

All the permanent funds, it will be noted, have been invested in government securities, except a balance too small to buy a War Savings Stamp.

Respectfully submitted,

J. M. ALDRICH, *Treasurer.*

REPORT OF THE MANAGING EDITOR.

I am happy to report that in spite of the unsettled conditions of the year we have been able to carry the ANNALS through without, we believe, any very vital loss. Aside from delays in the issue of the June and September numbers due to labor conditions, our schedule has been maintained and the volume of 450 pages with an interesting variety of contributions will compare favorably with preceding volumes.

A number of authors deserve our thanks for their generosity in contributing toward the cost of using plates and the printers deserve credit for untiring efforts in the face of many difficulties.

The receipts of this office show a substantial gain over those of last year. The number of outside subscriptions has been somewhat increased and the sale of back numbers and reprints with contributions toward plates giving a favorable balance.

With the return of normal conditions and with a goodly lot of papers already in hand for the next volume, I believe we may feel assured of a good showing for the coming year.

RECEIPTS.

Subscriptions	$275.88
Reprints	138.30
Back Volumes	93 66
Total	$507.84

DISBURSEMENTS.

Stamps and P. O. Deposits	$ 19.70
Work wrapping Annals	2.25
Paid to Treasurer	485.89
Total	$507.84

Respectfully submitted,

HERBERT OSBORN, *Managing Editor.*

REPORT OF TREASURER OF THOMAS SAY FOUNDATION.

(Copy not on hand at time of going to press.)

This concluded the reports of officers. The reports of the Resolutions, Auditing and Nominating Committees were then presented, as follows:

REPORT OF THE COMMITTEE ON RESOLUTIONS.

Your Committee on Resolutions begs to report as follows:

That the Society recognizes with a special sense of loss the death of our lamented honorary fellow, Dr. S. W. Williston, and recommend that a special memorial be prepared for publication in the ANNALS.

That we learn with sorrow of the loss by death of our fellow, Frederick Knab, and of charter members, Chas. A. Hart, W. Hague Harrington, V. A. E. Daecke, and members Vernon P. King and Thomas P. Lucas.

That we desire to accord special praise to those of our members who have courageously served in the war and with profound sorrow the deaths of those who have lost their lives in this service.

That we extend the thanks of the Society to the officers of Johns Hopkins University for the privileges afforded in connection with meeting places and other favors during the present meeting.

HERBERT OSBORN,
T. H. PARKS,
J. J. DAVIS.

REPORT OF AUDITING COMMITTEE.

Dec. 26, 1918.

Your Committee has examined the records, vouchers and property reported by Secretary-Treasurer J. M. Aldrich and Editor Herbert Osborn of the ANNALS, and find the same to be correct and properly kept.

H. A. GOSSARD,
GEO. A. DEAN,
FRANK M. GIBSON.

REPORT OF NOMINATING COMMITTEE.

The Nominating Committee beg leave to nominate the following officers for the coming year:

President—JAS. G. NEEDHAM.
First Vice-President—J. W. FOLSOM.
Second Vice-President—R. V. CHAMBERLIN.
Secretary-Treasurer—J. M. ALDRICH.
Additional Members Executive Committee—F. E. LUTZ, ARTHUR GIBSON, G. A. DEAN, G. C. CRAMPTON.

Respectfully submitted,

H. A. GOSSARD,
W. A. RILEY,
J. M. ALDRICH.

On motion, the report of the Nominating Committee was adopted, and the Secretary instructed to cast the ballot of the Society for the officers nominated; which being done, the President pro tem declared them duly elected.

Under general business, Dr. Headlee moved that it is the sense of the meeting that each annual program should have one session devoted to a symposium on some general entomological topic. Seconded and carried.

Professor W. A. Riley proposed an amendment to the Constitution, which was allowed to lie upon the table until the next annual meeting, as required by the Constitution.

At 10:05 A. M. the meeting adjourned.

J. M. ALDRICH, Secretary.